

EROSION CONTROL AT OUTER ISLAND LIGHT STATION REVISED ENVIRONMENTAL ASSESSMENT

Apostle Island National Lakeshore, Wisconsin

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1.0 PURPOSE AND NEED

The National Park Service (NPS) proposes to develop and implement erosion control measures at Outer Island Light Station that will stabilize slopes adjacent to the structure and will halt ongoing erosion from the toe and face of the slope. There is an immediate need to take action on the erosion problems adjacent to the Outer Island Light Station. There is evidence that damage is occurring at the site with the most recent mass wasting of the slope face occurring in 2001. This continuing erosion of the steep bluffs immediately below the building complex critically threatens the light station. Erosion has advanced to within 50 feet of the shoreward structures on Outer Island. Failure to act promptly could result in damage or loss of structures, possibly with the next high water cycle of Lake Superior. Engineering studies indicate that a return to the high lake levels of the mid-1980s and or excessively wet weather could result in significant loss of the resource at Outer Island in 10 to 20 years.

This Environmental Assessment (EA) is a revision of the 1999-2000 draft EA for Erosion Control at Raspberry and Outer Island Light Stations. Following completion of the earlier draft EA, design refinements were made for both projects and it was decided that the two projects should be handled separately. A revised EA was prepared for Raspberry Island in 2001 and the Finding of No Significant Impact was signed on November 2001. The Outer Island erosion control project became a FY 08 NPS construction line item, and it may be funded as early as FY 03. Given these circumstances, it was necessary to revise the earlier draft EA and update it for proposed erosion control work at Outer Island.

The specific purposes of the actions described in this EA include the following:

- Preserve the light station complex in its entirety as elements of the cultural landscape.
- Halt erosion and stabilize the slope in front of the light station using the least intrusive engineering techniques possible.
- Minimize temporary and permanent impacts to adjacent waters of Lake Superior.
- Minimize temporary and permanent impacts to any surrounding undeveloped lands including historic forest reserves and/or areas pending possible wilderness designation under the provisions of PL 88-577 (The Wilderness Act).
- Minimize impacts to littoral drift around the islands important to natural sandscapes.
- Preserve public access to the island and its cultural resources.
- Minimize long-term maintenance of any installed structural engineering elements.
- Maintain safety for public boating near the light station access points during and after construction.
- Minimize the impacts from the staging of equipment and materials during construction.

2.0 BACKGROUND

2.1 Project Background and Scope

Outer Island is one of 21 islands included within the Apostle Islands National Lakeshore (APIS) located off the tip of the Bayfield Peninsula in Bayfield County, Wisconsin. The region is approximately 80 miles east of Duluth, Minnesota and 20 miles north of Ashland, Wisconsin (Figure 1). APIS was established September 26, 1970, by Public Law 91-424. This enabling legislation charges the NPS with conserving and developing geographic, scenic, scientific, and historic resources of 21 of the 22 Apostle Islands and a segment of the mainland lakeshore of northern Wisconsin for inspiration, education, recreational use, and public enjoyment.

APIS contains significant natural, cultural, scenic, and recreational resources, including stands of northern hardwood forest in old growth condition, colonial bird nesting areas, unique sandscapes, and 160 structures listed on or eligible for, the National Register of Historic Places (NRHP). Among these cultural resources is the largest collection of light stations in the National Park System.

Six light stations were constructed on the Apostle Islands between 1856 and 1891 to aid in navigation around reefs and shoals and to lead shipping traffic into harbor (NPS, 1987). These light stations, which remain largely intact, are located on Sand, Raspberry, Michigan, Devils, Outer, and Long Islands. The stations are listed under Number 77000145 in the NRHP. They were placed on the state inventory in 1975 and have Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) documentation. Outer Island Light Station is the most remote of the light stations being situated approximately 23 miles from the mainland.

Automated lights that have replaced the original lights at the light station locations are still important to Lake Superior shipping and navigation. Responsibility for maintaining and preserving the light stations was transferred from the U.S. Coast Guard to the NPS by Public Law 99-497. The Coast Guard continues to be responsible for the modern navigational lights. The Coast Guard continues to operate a navigational beacon mounted in the historic Outer Island Light Station lighthouse (Van Stappen and Kovar, 1987).

The APIS Statement of Management, approved June 15, 1993, directs the NPS to preserve and maintain historic structures, landscapes, and artifacts to prescribed treatment levels at National Register sites. Preservation of cultural resource assets is also required in the APIS General Management Plan (NPS, 1989). Currently, the Outer Island Light Station is threatened by continuing natural erosion of adjacent steep clay banks (Figure 2).

In the mid-1970s, the NPS Denver Service Center conducted a study to gather baseline information and to make mitigation recommendations regarding erosion rates at several islands. A series of additional studies followed during the mid-1980s during a time when Lake Superior water levels were at record highs, which increased ongoing erosional processes. Milfred and Valaga (1983) conducted studies to identify areas of active erosion and to develop methods of quantifying the rates of erosion. Mickelson and Edil (1984) evaluated the erosion problems at Outer Island and recommended toe stabilization and bluff restoration. In 1986, the Wilhelm Engineering Company, Inc. conducted a detailed study of shoreline erosion and slope stability at Raspberry, Outer, and Michigan Islands. Four different engineering alternatives were suggested to stabilize the slope at Outer Island. The approaches to erosion control at this location involved various combinations of slope regrading, the use of geogrids and retaining walls, interception of surface drainage at the top of the slopes, and toe stabilization (Wilhelm, 1987). EAs were written addressing the alternatives proposed in the Wilhelm study (Van

Stappen and Kovar, 1987). The Preferred Alternative to address erosion problems at Outer Island in that proposal involved using riprap at the toe of the slope extending lakeward and erosion and drainage control at the top of the slope. With this approach the slopes would be allowed to erode naturally to a stable angle (Van Stappen and Kovar, 1987). The tramway at the site was to be stabilized using a series of soldier beam retaining walls.

Despite the peak in concern about the threats of erosion to the Outer Light Station in the mid-1980s, a lack of funding restricted erosion control measures to the placement of some large riprap along the toe of the slope at Outer Island (Figure 3). As a result, erosion has continued. A bluff erosion monitoring program is described in the Resource Management Report (RMR 91-4) (Van Stappen, 1991). Under this program, rates of erosion are measured every two years unless there is indication of rapid erosion. From 1978 to 1991, the highest erosion rate at Outer Island was in front of the signal house where it averaged between 0.98 and 1.18 feet/year. Historic erosion rates (between 1882 and 1989) were estimated at an average of 0.36 feet/year (Van Stappen, 1991). A NPS Form 10-238 addressing control of erosion on Outer Island was completed in May 1996. The title of the Development/Study Package Proposal is "Save Historic Light Stations from Bank Erosion, Package 6140-839. The projects are included as statements APIS-C-435 in the currently approved Resources Management Plan.

2.2 Relationship to Other Actions and Plans

The alternatives defined as proposed actions in Section 3.0 would be implemented on a limited area in front of the light station at Outer Island. There are no other APIS planning projects in the vicinity of the Outer Island Light Station nor have any recent actions been taken by the NPS in the vicinity of the Outer Island Light Station.

2.3 Issues

The broad issues associated with the proposed actions at Outer Island involve preparation of existing eroded bluff slopes to receive large quantities of fill material transported to the island. Preparation of the slopes would include removal of existing plant material and blending of the fill soils with the existing soils on the slopes and at the ends of the construction zones where the regraded slopes meet natural slopes that would continue to erode. The regraded slopes would need to be quickly revegetated to prevent sheet and rill erosion.

Personnel and equipment would also need to be transported to the work sites and would require logistical support in terms of food, water, fuel, and waste disposal. The proposed actions would require the introduction of fill materials (soil and stone) into waters of the U.S. Equipment would be needed in nearshore areas to place and stabilize fill materials.

2.4 Compliance with Federal or State Regulations

This EA has been prepared to evaluate the impacts of the reasonable alternatives described in Section 3.0. The EA is prepared in accordance with the *National Park Service's Director's Order No. 12: Conservation Planning, Environmental Impact Analysis, and Decision Making*, its accompanying handbook, and the provisions of the National Environmental Policy Act of 1969 (NEPA) (PL 91-190, 42 USC 4321-4247). Detailed procedures for developing this document comply with the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508).

**Figure 1
Vicinity Map**

**Figure 2
Existing Site Plan**

Figure 3
Cultural Resources On Site and Erosion Progression

NATIONAL PARK SERVICE

NPS jurisdiction of surface waters extends only 0.25 mile from the shoreline of each island. The State of Wisconsin owns the lake bottom within APIS, which is defined as all lands at or below 602 feet. International Great Lakes Datum (IGLD 85). The IGLD designation refers to a geodetic leveling measurement of elevation within the Great Lakes region and was updated in 1985. The International Joint Commission regulates all the Great Lake Levels, including Lake Superior.

Regulatory requirements, which may be applicable to the activities addressed in this EA, include:

- Section 106 of the National Historic Preservation Act addressing any activities directly impacting structures on National Register sites or impacting the cultural landscape/setting of Register sites.
- Section 404 of the Clean Water Act permitting and state water quality certification through Section 401 of the Act.
- Chapter 30.12, Wisconsin Statutes to install riprap.
- Section 10 of the Rivers and Harbors Act of 1899 related to placement of fill in navigable waters.
- Section 307 of the Coastal Zone Management Act requiring a consistency determination through Wisconsin's coastal zone management program.
- Wisconsin Shoreland Management Program (Wis. Admin. Code Ch. NR 115) and Shoreland-Wetland Protection Program (Wis. Admin. Code Ch. City & Village, 117).
- Section 7 consultation with the U.S. Fish and Wildlife Service on any issues impacting endangered species.

Under NPS final procedures for implementing Executive Orders 11988, "Floodplain Management," and 11990, "Protection of Wetlands," actions that are functionally dependent on water are excepted from compliance with these orders.

3.0 ALTERNATIVES

This EA addresses NPS Development/Study Package Proposal Package 6140-839, “Save Historic Light Stations from Bank Erosion.” Package 839 addresses erosion problems at Outer Island. Congressional approval has been received to proceed with the environmental documentation and design documents. An impact comparison of the various alternatives is given in Table 1 on pages 38 through 41.

3.1 Actions Common to All Alternatives

Compared to other islands within the National Lakeshore, Outer Island presents additional logistical difficulties for any type of engineering work given its distance of over 20 miles from the mainland and its greater exposure to wave action and storms on Lake Superior. The four action alternatives proposed for Outer Island in this EA focus on building the existing bluff slope up and out combined with various approaches to toe-of-the-slope stabilization. All of the action alternatives involve constructing a trench around the light station to drain groundwater, importing fill to reconstruct the existing slope without cutting back the current top of the slope, and determining an appropriate way to transport materials to the island without harming its resources. Construction of all alternatives, with the exception of the No-Action Alternative, may extend over several years, taking into account the fact that the annual “construction season” on Outer Island is only 3-4 months (Kretschman personal communication). Construction crewmembers would most likely live on the island during the construction season in existing facilities or in tents or temporary structures that the contractor would provide.

A trench would be constructed around the perimeter of the light station grounds to intercept subsurface drainage and divert it through discharge pipes to the base of the bluff and into the lake. This trench would be constructed with a perforated pipe covered with geofabric. Filter stone with geofabric wrapped around it would be placed in the bottom of the trench.

All fill, topsoil, and stone/rock would be brought from the mainland via barge pulled by a tug. The fill materials will meet the requirements of Section 208 of the State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction for borrow material. They will also come from sources certified by the contractor as free from invasive, exotic plant material and taken from below the top 10 inches of topsoil. An erosion control plan approved by the Wisconsin Department of Natural Resources (WDNR) will be used to prevent erosion and sedimentation during construction and prior to permanent slope revegetation. Coordination with the U.S. Army Corps of Engineers and WDNR would be needed to insure proper Section 404 and 401 permitting under the Clean Water Act, and Section 10 consultation with the U.S. Coast Guard would be needed under the Rivers and Harbors Act. The amount of fill used is likely to vary depending upon the configuration of the regraded slope and each action alternative. The amounts given for the action alternatives are estimates. A final determination regarding fill amounts will not occur until the detailed design phase of the project.

Shallow water conditions immediately off shore from the Outer Island Light Station necessitate accommodations be made for access by barges carrying materials, equipment, and personnel. The preferred approach to facilitating barge access would be to dredge an access channel. However, this approach may not be feasible if bedrock is found at or right beneath the lake bottom at this location. If dredging cannot be done because of shallow bedrock, another option for transporting materials from barges to the light station might include constructing a temporary pier (composed of rock and a deck or constructed of anchored pontoons) from shore to deepwater for use as a haul road and dock. There is also a possibility that a partnership with

the Army Reserves could provide a temporary Armored Vehicle Landing Device (AVLD) to move equipment and materials on to the island. No temporary haul road will be established along the shoreline of Outer Island connecting the light station area with any other site on the island that might be more suitable for barge docking.

Bioengineering of the slopes (ca. $\frac{3}{4}$ acre) would be accomplished subsequent to toe stabilization, installation of the drainage trench at the top of the slope, and regrading the slope. Bioengineering would be used to stabilize the slope above the toe stabilization. Potential bioengineering approaches include, but are not limited to, fascines, brush layers, and interplanting with native forbs and grasses. Fascines are bundles of dormant woody branch cuttings placed in shallow trenches running parallel to the slope. Brush layers, which are somewhat larger, work in the same manner as fascines. Bioengineering methods would be immediately effective in reducing erosion and shallow sliding, and would increase in effectiveness over time as cuttings sprout and take root on the slope.

3.2 Alternatives

3.2.1 No-Action Alternative

In 1984 and 1986, large armor rock was placed at the base of the existing slope in front of the Outer Island Light Station to provide temporary toe protection. In 1982, the area immediately east of the tramway/stairs was stabilized with five wooden retaining walls, which are now showing signs of failure (see Section 4.1 and Figure 3). This alternative would consist of leaving in place large armor rock installed along the toe of the slope in 1984 and 1986 and allowing the wooden retaining walls installed next to the tramway in 1982 to continue their deterioration (Van Stappen and Kovar, 1987). With this alternative only minimal stopgap measures would be taken by the NPS similar to those measures taken over the past several decades such as installation of some additional armor stone along the shoreline and replacement of existing retaining walls. Under this alternative, eventual loss of some of the light station cultural resources would be likely before the bluff face would naturally erode back far enough to stabilize.

3.2.2 Alternative 1 (Breakwater)

Alternative 1 involves constructing a breakwater extending approximately 325 feet east and approximately 300 feet west and north of the existing concrete breakwall and pier (Figures 4 and 5). The breakwater structures would be composed of core stone, filter stone, and armor stone. The breakwater structures would rise approximately 11 feet above current lake water levels except where tapered to tie into the concrete pier, which is approximately four feet above water level. Both ends of the breakwater would tie into the existing shoreline to reduce flanking. Openings between breakwater structures would typically be 40 to 50 feet wide. A cobble beach comprised of 1 to 6-inch diameter material would be placed between the landside of the breakwater structures and the regraded slope in front of the light station. Fill for the regraded slope would extend up to 25 feet into the lake beyond the existing shoreline. Alternative 1 would take an estimated eight to nine months of construction time to complete.

Figure 4
Alternative 1—Breakwater Plan View

Figure 5
Alternative 1—Breakwater Cross Section

3.2.3 Alternative 2 (Revetment-Preferred Alternative)

This alternative would include using fill to regrade the existing slope and construct a continuous revetment extending approximately 325 feet east and 300 feet west and north from the concrete breakwater and pier (Figures 6 and 7). Both ends of the revetment would be toed into the lakebed via a two-foot deep excavation or excavation to bedrock. This “toed-in” design would only be viable if excavation to bedrock is possible. The “toed in” design would not be necessary if the lakebed adjacent to the light station is bedrock. The top of the revetment (armor stone) would rise to an elevation of 605 feet IGLD 85 and a layer of filter stone would be added from elevation 605 to 609 feet IGLD 85.

The revetment would rise approximately 4 to 7 feet above the current water level and would extend 10 feet lakeward from the toe of the reconfigured slope before angling into the water. The lakeward side of the revetment would end in approximately 3 to 4 feet of water based on the current lake water level. Revetment construction would consist of an inner earth fill covered with geotextile, a layer of 800-pound filter rock and a double layer of 2 to 4 ton armor stone extending lakeward beyond the toe. This alternative would take an estimated eight to nine months of construction time to complete.

3.2.4 Alternative 3 (Islands)

Several free-form islands would be constructed from 50 to 90 feet offshore as part of this alternative. The islands would extend approximately 325 feet east and 300 feet west and north from the existing concrete breakwall and pier (Figures 8 and 9). The constructed islands would be roughly 90 feet long and 20 to 50 feet wide with gaps of 20 to 50 feet between them. The lakeside of the islands would be constructed to the specifications indicated for the breakwater in Alternative 1; extending roughly 325 feet east and 300 feet west and north of the existing concrete breakwall and pier with an elevation of 10 feet above current lake levels. Filter stone and soil would be placed behind the elevated lakeside of the islands, and the landside of the islands would taper down to lake-level. The soil and stone would be stabilized with natural plant material. A cobble beach, comprised of 1 to 6-inch diameter material, would extend from the toe of the regraded slope to the landside of the islands. The toe of the regraded slope would extend approximately 25 feet farther into the lake than does the toe of the existing slope. Alternative 3 would take an estimated 13 months of construction work to complete.

3.2.5 Alternative 4 (Submerged Breakwater with Revetment)

Alternative 4 involves construction of a submerged breakwater extending approximately 325 feet east and 300 feet west and north from the existing concrete breakwall and pier (Figures 10 and 11). The submerged breakwater, constructed of two layers of 3 to 4 ton armor stone, would run parallel to and approximately 50 feet from a shoreline revetment. The ends of the submerged breakwater would tie into the existing shoreline. The top of the submerged breakwater would be approximately 601 feet IGLD 85 or at the present lake level. The shoreline revetment would be constructed using rubblemound revetment and tied into the existing shoreline to reduce flanking. The top of the revetment in Alternative 4 would be approximately four feet above the current lake water level and extend out into the lake. Armor stone for both the submerged breakwater and the revetment would be placed to maximize interlocking to prevent movement from storm wave action. Fill would be used on the slope of the bluff behind the revetment to create a stable slope angle.

3.2.6 Alternatives Considered but Dismissed

Van Stappen and Kovar (1987) developed a number of alternatives based on the Wilhelm's study of 1986 to erosion control on Outer Island. The alternatives based on Wilhelm's work and described by Van Stappen and Kovar (1987) were reconsidered during the kickoff meeting for this current effort in October 1999. All of the alternatives briefly described below were dismissed.

The former Alternative 1 described by Van Stappen and Kovar (1987) consisted of:

- Shoreline protection using riprap, armor rock over geotextile and extending lakeward.
- Installation of a filter fabric-lined and gravel-filled trench drain at the top of the bluffs parallel to the slope face to intercept surface water runoff and groundwater.
- Stabilizing the tramway with a series of soldier beam retaining walls.
- Allowing the bluff to erode naturally to a stable slope.

The former Alternative 3 involved:

- Slope toe erosion control using a geogrid reinforced slope toe and overlying armor rock at the toe of the slope extending lakeward.
- Reconstructing the slope as a reinforced earth (geogrid) structure with erosion control matting on the face of the slope to encourage revegetation.
- Constructing a geodrain behind the reconstructed slope to intercept groundwater seepage.

A variation of this alternative was also suggested. This would consist of a 10 foot setback bench with a 10-foot high wooden retaining wall (geogrid reinforced earth with a timber facing) incorporated into the slope at approximately the 630 foot elevation.

The former Alternative 4 as described by Van Stappen and Kovar (1987) involved:

- Cutting back the existing slope to a stable 2:1 configuration.
- Shoreline protection using riprap at the toe of the slope.
- Erosion control at the top of the slope using a trench drain as in Alternative 1.

All of these alternatives were rejected for several reasons. Primarily, there was a desire to avoid cutting back into the existing slope or allowing the existing slope to further erode naturally thus bringing the top of the bluff precariously close to existing light station structures. Additionally, there was a concern that the design of Wilhelm's alternatives would be unsightly and that they may have resulted in the transport of excessive amounts of material to the island, creating increased costs, a larger impact on nearshore benthic organisms, and hazards for recreational boaters. These same justifications for dismissing this alternative from further consideration continue to exist.

A fifth alternative as presented in Van Stappen and Kovar proposed moving four of the light station buildings including the light house itself back from the edge of the bluff and stabilizing the tramway with a series of soldier beam retaining walls was briefly considered in the 1987 study (Van Stappen and Kovar). However, this alternative was dismissed from further consideration for economic reasons and for its direct impacts on the cultural resources and cultural landscape as well as impacts on adjacent forest reserves and potential designated wilderness areas.

Figure 6
Alternative 2—Revetment Plan View

Figure 7
Alternative 2—Revetment Cross Section

Figure 8
Alternative 3—Islands Plan View

Figure 9
Alternative 3—Islands Cross Section

Figure 10
Alternative 4—Submerged Breakwater and Revetment Plan View

Figure 11
Alternative 4—Submerged Breakwater and Revetment Cross Section

3.3 Impact Topics Selected for Analysis

3.3.1 Geology, Soils, and Topography

The glacial till soils on the bluff slopes in front of these light stations have been eroding since the retreat of the last glacier and they form a characteristic geologic and topographic feature of APIS. Erosion from the island bluffs also contributes to littoral drift around the islands and the formation of sand spits and tombolos (a coastal feature that forms when a sandbar joins an island to the mainland or two islands together). Action alternatives involve adding fill to the existing slopes and modifying the on-going geologic process of erosion. The shoreline and bluff topographies would be modified by implementation of action alternatives involving fill material and the construction of various shoreline or nearshore structures such as revetments and breakwaters.

3.3.2 Water Quality

All action alternatives involve construction activities and the placement of fill in Lake Superior waters. The maintenance and long-term preservation of current high quality freshwater habitat surrounding the islands is an important consideration when undertaking any activity in or adjacent to these oligotrophic waters. Additionally, potable water for park facilities around APIS is drawn from the lake and could be potentially impacted by any activity decreasing nearshore water quality.

Waters of the U.S. (i.e., Lake Superior) would be directly impacted by the action alternatives. Clean Water Act Section 404 and Section 401 permits, as well as a Section 10 permit under the Rivers and Harbors Act, would be required prior to implementation of any action alternative involving the placement of fill into lake waters. The general impacts of fill placement are covered under discussion of water quality.

3.3.3 Ecological Resources (Flora and Fauna Including Threatened and Endangered Species)

The bluff slopes on Outer Island comprise a clayscape ecosystem with characteristic flora and fauna (Judziewicz and Koch, 1993). All action alternatives would result in the loss of flora currently existing on these clayescapes in the immediate vicinity of the light station. However, the clayscape community in front of the light station has been heavily colonized by numerous introduced plant species as a result of disturbance and the proximity of human horticultural activity. A small population of the state-listed grass-of-parnassus (*Parnassia palustris*) may exist on the bluff slope at the Outer Island Light Station. However, a recent survey did not locate any of these plants within the project area (Judziewicz, 2001). The shallow water littoral area adjacent to the light stations would be disturbed by all action alternatives. Some of the action alternatives would create additional structure and habitat that could provide long-term benefits to organisms inhabiting the littoral zone.

3.3.4 Visitor Use and Experience

All alternatives have the potential to directly impact visitor experience and use in the short-term. Temporary impacts of equipment noise and possible roping off of some areas would likely occur during construction. However, the goal of all action alternatives is to stabilize the area of the light station and its associated buildings. Accompanying interpretive programs on Outer Island would be impacted by the action alternatives.

3.3.5 Aesthetics

Views of the water and island shorelines as well as of the cultural resources on the islands are important aesthetic components of APIS landscape. All alternatives would impact the short-term and long-term appearance of the Outer Island Light Station's natural and cultural landscapes. The short-term impacts would be related to construction efforts and would substantially change the views associated with Outer Island. All of the action alternatives seek to minimize any changes in the aesthetic appearance of the island and result in negligible, long-term impacts.

3.3.6 Cultural Resources (Historic Structures and Landscapes)

The light stations are the most visible historic resources in APIS, and Outer Island is no exception. The goal of all action alternatives is the preservation of the historic structures associated with the light station at Outer Island. Although there has not been a formal cultural landscape inventory performed at Outer Island Light Station, the NPS considers the area around the light station (and the light station itself) an important part of the cultural landscape on Outer Island. Therefore, each action alternative also takes into account how the cultural landscape would be impacted and ultimately preserved.

3.3.7 Cultural Resources (Archaeology)

All action alternatives would involve soil disturbance on the grounds of the historic Outer Island Light Station with the main soil-disturbing activity being installation of a drainage trench. The bluff area, shoreline and nearshore underwater areas adjacent to the light station would also be disturbed by any construction associated with action alternatives. Limited archaeological surveys have identified some historic archaeological resources on and around the Outer Island Light Station.

3.4 Impact Topics Eliminated from Further Evaluation

3.4.1 Floodplains and Wetlands

As mentioned in Section 2.5, under NPS final procedures for implementing Executive Order 11988 "Floodplain Management" and 11990, "Protection of Wetlands," actions that are functionally dependent on water are excepted from compliance with these orders. Furthermore, floodplains and wetlands do not exist within the project area on Outer Island (Van Stappen, personal communication).

3.4.2 Prime and Unique Farmlands

There are no prime or unique farmlands located anywhere on Outer Island. The project area on the island is remote and has never been, and is not now, in agricultural production.

3.4.3 Regional Air Quality

Some temporary air emissions from construction equipment and fugitive dust from the handling and placement of fill would occur with any of the action alternatives. However, any impacts would be highly localized and temporary with negligible impacts on regional air quality.

3.4.4 Solid and Hazardous Materials

Relatively small quantities of petroleum products have historically been used at the site for power generation. However, there is no known history of significant spills of these materials. Park personnel have anecdotal information that some batteries used on site may be buried on the light station grounds or may have been dumped into the lake. Some buried lead batteries are apparently known to exist east of the lighthouse. Coal ash and other wastes may have historically be thrown into the lake, but this is not definitely known. Hazards associated with fuel storage, transfer, and use during construction associated with action alternatives described in this EA are discussed under water quality issues. Plan notes on construction drawings will direct contractors to notify NPS personnel should any unknown hazardous materials or wastes be encountered during any phase of construction. Appropriate remedial actions will be developed should such materials be encountered.

3.4.5 Environmental Justice

Under a policy established by the Secretary of the Interior, to comply with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*, departmental agencies should identify and evaluate, during the scoping and/or planning processes, any anticipated effects, direct or indirect, from the proposed project or action on minority and low-income populations and communities, including the equity of the distribution of the benefits and risks.

The Red Cliff and Bad River Bands of Lake Superior Chippawa Indians have reservation lands in the vicinity of APIS, and tribal representatives have been included in early coordination and scoping of the prior EA and this EA (see Section 8.0). These tribal representatives have voiced no concerns. The nature of any of the action alternatives is such that there would be no direct impact on tribal members or their lands. Indirect regional socioeconomic impacts of the various alternatives would be similar for these minority populations as for the regional population at large.

3.4.6 Socioeconomics

Although the park is located in both Ashland and Bayfield Counties Wisconsin, APIS Headquarters is located in Bayfield County with a population of a little more than 15,000 (U.S. Census, 2000). The city of Bayfield is one of 19 incorporated towns and villages within Bayfield County and has a population of approximately 700 year-round residents. Bayfield's economy is heavily dependent upon tourism associated with APIS. Per capita income in the county was \$16,407 in 2000 compared to the Wisconsin state average of \$22,271 (US Census, 2000). The largest components of the Bayfield County economy in 2000 were educational and social services (22.4 percent), construction and retail trade (10.3 percent and 10.6 percent, respectively), and manufacturing (9.1 percent) with a county unemployment rate of 10.0 percent. The median value of a home in Bayfield County was \$86,200 in 2000 (U.S. Census, 2000). Demographically, the majority of the population in Bayfield County is Caucasian (88.5

percent), however Native Americans, with 9.4 percent of the population, make up the second largest ethnic group. Other represented ethnic groups are African-Americans (0.1 percent), Hispanic (0.5 percent), and Asian-Americans (0.3 percent).

Although the entire APIS is a major tourist destination and has a direct socioeconomic impact on the local Bayfield economy, Outer Island itself does not have any year-round residents, regular ferry or concessionaire traffic, or direct connections to mainland businesses. It is likely that construction jobs would have some economic impacts to the local region, but those impacts would be negligible in terms of the regional economy. Following implementation of the proposed action, there may be additional interest to visit Outer Island, but the level of interest would be difficult to quantify and, again, would have a negligible impact on the regional economy. For these reasons, socioeconomics is dismissed as an impact topic.

3.4.7 Ethnographic Resources

An ethnographic inventory of several of the Apostle Islands, including Outer Island, was conducted in 2000 (Zedeno, et. al., 2000). Ojibwe representatives interviewed on site indicated that the primary ethnographic resources associated with Outer Island included the old growth area (Grandfather trees), a spring of presently unknown location, and caves along the island cliffs. None of these features are present within the light station project area. Therefore, impacts to ethnographic resources will not be analyzed in this EA.

3.4.8 Museum Collections

There are no museum collections housed on Outer Island, nor will any of the collections located on the mainland be impacted in any way by the proposed action, therefore museum collections will not be considered as an impact topic.

3.4.9 Soundscape Management

In accordance with NPS *Management Policies* (2001) and Director's Order #47, *Sound Preservation and Noise Management*, an important part of the NPS mission is preservation of natural soundscapes associated with national park units. Natural soundscapes exist in the absence of human-caused sound. The natural ambient soundscape is the aggregate of all natural sounds that occur in park units, together with the physical capacity for transmitting natural sounds. Natural sounds can be transmitted through air, water, or solid materials. The frequencies, magnitudes, and duration of human-caused sound considered acceptable varies among NPS units depending upon the level of surrounding development.

Hauling material, operating construction equipment, and long-term operation of the light station would result in human-caused sound; however, the noise impacts from construction operations would only last during construction. Following construction activities the island would revert back to its normal soundscape, therefore soundscape management was dismissed as an impact topic.

3.4.10 Lightscape Management

In accordance with NPS *Management Policies* (2001), the NPS strives to preserve natural ambient landscapes, which are natural resources and values that exist in the absence of human-caused light. The construction activities within the proposed action would take place primarily during daylight hours and would not call for any additional, permanent lighting on Outer Island. Any temporary or new light sources would be designed to keep light on the intended subject and out of the night sky. Therefore, lightscape management was dismissed as an impact topic.

3.5 Impact Comparison Matrix

[Table 1](#) contains the Impact Comparison Matrix.

3.6 Mitigation Measures

Mitigation measures have been designed to minimize, reduce, or eliminate impacts of implementing the proposed actions on the resources on Outer Island.

3.6.1 Soil Erosion/Sedimentation

To minimize soil erosion, the following mitigation measures would be incorporated:

- Standard erosion control measures {i.e., Best Management Practices (BMPs)} such as silt fences, sand bags, or equivalent control methods will be used to minimize any potential soil erosion during construction. Silt curtains will be used in littoral areas to confine any suspended sediment.
- Filter fabric, temporary vegetative cover, and/or other means will be used as necessary between construction seasons to ensure stabilization of disturbed soils.
- Any revegetation effort for erosion control will use site-adapted native seed and/or plants.

3.6.2 Exotic Vegetation

In order to prevent the introduction and minimize the spread of exotic vegetation and noxious weeds, the following mitigation measures would be incorporated into all action alternatives:

- All construction equipment will be pressure washed prior to entering the National Lakeshore.
- If the staging area for construction equipment were located on the island, it will be park approved and treated for exotic vegetation, if necessary.
- Use of hay for erosion control measures will be prohibited due to the likelihood of weed seeds in hay.
- If straw were utilized for erosion control measures it will be state-certified weed-free straw.
- All areas disturbed by construction will be revegetated using site-adapted native seed and/or plants.
- All landscaping efforts will utilize native plants.
- Monitoring and follow-up treatment of exotic vegetation on revegetated areas will occur for two to three years following construction. Follow-up treatment could include mechanical, biological, chemical, and/or additional revegetation treatments.

Table 1
Impact Comparison Matrix for Outer Island

Resource Area	No-Action Alternative	Alternative 1 (Breakwater)	Alternative 2 (Revetment—Preferred Alternative)	Alternative 3 (Islands)	Alternative 4 (Submerged Breakwater and Revetment)
Geology, Soils, and Topography	The No-Action Alternative would have a negligible impact on the geologic conditions and processes associated with the bluff face of the Outer Island Light Station including bluff erosion, shoreline topography, and littoral drift.	Alternative 1 would have moderate, short-term and long-term, adverse impacts on bluff erosion and on shoreline topography. This alternative would have a long-term, minor, adverse impact on littoral drift.	Alternative 2 would have minor, long-term adverse impacts on bluff erosion; minor short-term and long-term, adverse impacts on shoreline topography, and negligible impacts on littoral drift.	Alternative 3 would have a long-term adverse impact on erosion; a short-term and long-term moderate adverse impact on natural island shoreline topography; and a long-term minor, adverse impact on littoral drift.	Alternative 4 would have a long-term, minor adverse impact on erosion; short-term and long-term, moderate, adverse impact on shoreline topography; and a minor, long-term, adverse impact on littoral drift.
Water Quality	The No-Action Alternative would have a negligible impact on nearshore waters adjacent to Outer Island Light Station.	Alternative 1 would have a moderate, short-term, adverse impact on nearshore water quality in the vicinity of the Outer Island Light Station.	Alternative 2 would have a moderate, short-term, adverse impact on nearshore water quality in the vicinity of the Outer Island Light Station, though less than all other action alternatives since there would be less actual in-water work.	Alternative 3 would have a moderate, short-term, adverse impact on nearshore water quality and minor, long-term, adverse impact on nearshore water quality in the vicinity of the Outer Island Light Station from continuing island erosion.	Alternative 4 would have a moderate, short-term adverse impact on nearshore water quality in the vicinity of the Outer Island Light Station.

Resource Area	No-Action Alternative	Alternative 1 (Breakwater)	Alternative 2 (Revetment—Preferred Alternative)	Alternative 3 (Islands)	Alternative 4 (Submerged Breakwater and Revetment)
Ecological Resources (Flora)	The No-Action Alternative would have a negligible impact on the clayscape community, littoral community, and endangered species associated with Outer Island.	Alternative 1 would have a long-term, minor, adverse impact on the clayscape community. This alternative would also possibly have a long-term and short-term, minor, adverse impact on some components of the littoral community. However, it would also possibly have a long-term, minor, beneficial impact on other littoral flora by providing additional underwater habitat. There would be a negligible impact on endangered species.	Alternative 2 would have a long-term, minor adverse impact on the clayscape plant community. This alternative would have an overall negligible impact on the littoral community and on endangered species.	Alternative 3 would have a long-term, minor adverse impact on the clayscape plant community. This alternative would have a short-term and long-term, minor adverse impact on some species of the littoral plant community, while it may also have a long-term, minor beneficial impact by providing additional underwater habitat for other littoral species. There would be a negligible impact on endangered species.	Alternative 4 would have a long-term, minor adverse impact on the clayscape plant community. This alternative would have a short-term and long-term, minor adverse impact on some species of the littoral plant community, while it may also have a long-term, minor beneficial impact by providing additional underwater habitat for other littoral species. There would be a negligible impact on endangered species.
Ecological Resources (Fauna)	The No-Action Alternative would have a negligible impact on the terrestrial and aquatic fauna in the vicinity of the Outer Island Light Station. There would be no impact on state or federal-listed faunal species or on game fish populations.	Alternative 1 would have a short-term and long-term, minor, adverse impact on terrestrial faunal components of the clayscape community. This alternative would have a long-term, minor, beneficial impact on the littoral community adjacent to the light station through the addition of underwater structure associated with the breakwater. There would be no impact on state or federal-listed faunal species or on game fish.	Alternative 2 would have a short-term and long-term, minor, adverse impact on terrestrial fauna in the vicinity of the light station. It would have a negligible impact on the littoral faunal community. There would be no impact on state or federal-listed faunal species or on game fish.	Alternative 3 would have a short-term and long-term, minor, adverse impact on terrestrial fauna in the vicinity of the light station. It would have a short-term minor adverse impact from construction disturbance and a long-term, minor, beneficial impact on the littoral faunal community adjacent to the light station from increased underwater structure. There would be no impact on state or federal-listed faunal species or on game fish.	Alternative 4 would have a short-term and long-term, minor, adverse impact on the terrestrial faunal community in the vicinity of the light station. This Alternative would have a short-term, minor, adverse impact, but a long-term, minor beneficial impact on the littoral faunal community adjacent to the light station. There would be no impact on state or federal-listed faunal species or on game fish.

Resource Area	No-Action Alternative	Alternative 1 (Breakwater)	Alternative 2 (Revetment—Preferred Alternative)	Alternative 3 (Islands)	Alternative 4 (Submerged Breakwater and Revetment)
Visitor Experience	The No-Action Alternative would have short-term, negligible impacts on visitor use and experience. This alternative would have long-term, major, adverse impacts on visitor use and experience.	Alternative 1 would have short-term, moderate, adverse impacts on visitor access and experience because of construction activities. However, this alternative would have long-term, minor, beneficial impacts for visitors to the park in future years since it would enable interpretation of a unique cultural resource to continue.	Alternative 2 would have short-term, moderate, adverse impacts on visitor access and experience during construction activities. However, this alternative would have long-term, moderate, beneficial impacts for visitors to the park in future years since it would enable interpretation of a unique cultural resource to continue. Unlike other action alternatives, Alternative 2 would not involve construction of in-water structures potentially creating a navigational hazard to visitors.	Alternative 3 would have short-term, moderate, adverse impacts on visitor access and experience because of construction activities. However, this alternative would have long-term, minor, beneficial impacts for visitors to the park in future years since it would result in preservation of the unique, historic, cultural resources of the island.	Alternative 4 would have short-term, moderate, adverse impacts on visitor access and experience because of construction activities. However, this alternative would have long-term, minor, beneficial impacts for in future years since it would result in preservation of the unique, historic, cultural resources of the island.
Aesthetics	The No-Action Alternative would have a negligible, short-term impact, but could have a long-term, major, adverse impact on aesthetics.	Alternative 1 would have a short-term and long-term, moderate, adverse impact on the viewshed of the Outer Island Light Station.	Alternative 2 would have a short-term and long-term, minor, adverse impact on the Outer Island Light Station viewshed based on the historic appearance of the light station.	Alternative 3 would have a short-term and long-term, moderate, adverse impact on the historic viewshed of the Outer Island Light Station.	Alternative 4 would generally have a long-term, minor, adverse impact on the viewshed of the Outer Island Light Station from the lake using the historic appearance of the bluff slope and shoreline as a standard.

Resource Area	No-Action Alternative	Alternative 1 (Breakwater)	Alternative 2 (Revetment—Preferred Alternative)	Alternative 3 (Islands)	Alternative 4 (Submerged Breakwater and Revetment)
Cultural Resources	<p>The No-Action Alternative would have a short-term negligible, but long-term moderate or, possibly, major, adverse impact on the historic structures on Outer Island. This alternative would have a long-term moderate to major impact on the cultural landscape; and it would have a long-term minor adverse impact on historic archaeological resources.</p>	<p>Alternative 1 would have a long-term, moderate, beneficial impact on the historic structures on Outer Island Light Station by providing for long-term soil and foundational stability. This alternative would have a long-term, moderate adverse impact on the cultural landscape of the Outer Island Light Station. Alternative 1 would also have a short-term minor adverse impact on nearshore submerged archaeological resources and, possibly on any, as yet unidentified subsurface archaeological resources.</p>	<p>Alternative 2 would have a long-term, moderate, beneficial impact on the historic structures on Outer Island Light Station by providing for long-term soil and foundational stability. This alternative would have a long-term, moderate adverse impact on the cultural landscape. Alternative 2 would also have a short-term minor adverse impact on nearshore submerged archaeological resources and, possibly on any, as yet unidentified, subsurface archaeological resources.</p>	<p>Alternative 3 would have a long-term, moderate, beneficial impact on the historic structures on Outer Island Light Station by providing for long-term soil and foundational stability. This alternative would have a long-term, moderate adverse impact on the cultural landscape. Alternative 3 would also have a short-term minor adverse impact on nearshore submerged archaeological resources and, possibly on any, as yet unidentified, subsurface archaeological resources.</p>	<p>Alternative 4 would have a long-term, minor, beneficial impact on the historic structures on Outer Island Light Station by providing for long-term soil and foundational stability. This alternative would have a long-term, moderate adverse impact on the cultural landscape. Alternative 4 would also have a short-term minor adverse impact on nearshore submerged archaeological resources and, possibly on any, as yet unidentified, subsurface archaeological resources.</p>

3.6.3 Plant Species of Special Concern

In order to protect the state-listed grass-of-parnassus (*Parnassia palustris*) known to occur on the clayscape slopes next to the light station, the following mitigation measures will be incorporated into the proposed actions:

- A site-specific survey for grass-of-parnassus will be conducted during the summer (bloom period) in the vicinity of the proposed action.
- If grass-of-parnassus is found in the project area, it will be transplanted to suitable habitat on the northern end of Outer Island.
- Cuttings and seed will be collected from clayscape communities for use in revegetation of the slope after completion of any of the action alternatives.

3.6.4 Cultural Resources

To protect archeological resources, the following mitigation measure will be implemented:

- A Phase I archaeological survey will be conducted along the proposed alignment of the drainage trench surrounding the light station and at the edge of the bluff prior to commencement of any trench construction.
- If, during construction, previously undiscovered archeological resources are discovered, all work in the immediate vicinity of the discovery will be halted until the resources could be identified and documented. An appropriate mitigation strategy will have to be developed in consultation with the Wisconsin State Historic Preservation Office.
- In the unlikely event that human remains, funerary objects, sacred objects, or objects of cultural patrimony are discovered during construction, provisions outlined in the Native American Graves Protection and Repatriation Act (25 USC 3001) of 1990 will be followed.

3.6.5 Hazardous Materials

- Plan notes will direct contract personnel to immediately stop work should suspected hazardous materials or wastes be encountered. NPS personnel will be notified and appropriate remediation will be accomplished prior to resuming work.
- Refueling of equipment will take place only on impervious containment pads.
- Absorbent booms and other spill containment materials will be available on site during construction.

3.7 Environmentally Preferred Alternative

The environmentally preferred alternative is determined by applying the criteria suggested in NEPA, which is guided by the CEQ. The CEQ provides direction that "...the environmentally preferred alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101." Using the six criteria from Section 101 detailed below, it was determined that Alternative 2 (Revetment) is the environmentally preferred alternative because, of the alternatives evaluated in this EA, it provides the greatest level of protection. The rationale for this determination is provided for each criterion in the following discussion.

Criterion 1—Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

APIS is charged through its enabling legislation and the Organic Act with preservation of the geographic, scenic, scientific, historic resources, natural objects, and wildlife of the park. At issue is the preservation of the historic Outer Island Light Station within the context of the park's natural environment. While all action alternatives would preserve the light station by halting on-going erosion of the adjacent bluff face, Alternative 2 would accomplish this goal in the least intrusive manner regarding the cultural landscape and the littoral waters adjacent to the Outer Island Light Station. By keeping the structurally engineered portion of the revetment at approximately 4 feet above the average lake level, visual intrusion on the cultural landscape is minimized compared to Alternative 1. Additionally, less fill and therefore less direct impact on existing ecological conditions in the littoral zone of the island occurs with Alternative 2 than with Alternatives 1 (breakwater), 3 (islands), and 4 (submerged breakwater with revetment). The No-Action Alternative would result in continued bluff erosion with a high probability of eventual damage and loss of light station structures thus degrading interpretation of this historic site for future generations. Therefore, Alternative 2 best meets this criterion in terms of the tradeoff between needed historic structure preservation and preservation of the natural and scenic environments.

Criterion 2—Assure for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings.

Alternative 2 best meets this criterion in terms of boater and visitor safety by not changing the navigational environment of lake waters immediately adjacent to the light station as would Alternatives 1(breakwater), 3 (islands), and 4 (submerged breakwater with revetment). By keeping the structurally engineered portion of the revetment at approximately 4 feet, above the average lake level, visual intrusion on the cultural landscape is also much less than that for Alternatives 1 and 3. The No-Action alternative would result in continued unabated bluff erosion that could eventually threaten the structural integrity of various light station structures making the site unsafe to visit and resulting in the eventual total destruction of some structures.

Criterion 3—Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.

Of the action alternatives, Alternative 2 best meets this criterion by halting the threat of erosion to the light station using the least environmentally intrusive methods that minimize impacts on the cultural landscape, minimize placement of fill into the waters of Lake Superior, and minimize placement of structures in the nearshore waters that could become navigational hazards to recreational boaters and visitors. As with Criteria 1 and 2, the No-Action Alternative would permit continued degradation of the light station structures and increase the health and safety risks of visitors and NPS personnel in the vicinity of the light station.

Criterion 4—Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.

All of the action alternatives would preserve the cultural resources of Outer Island. However, Alternative 2 would accomplish this cultural resource preservation with the best accompanying natural resource preservation strategy. There would be no obvious differences between the various action alternatives in terms of their support of diversity and individual choice. None of the alternatives address handicapped access to the light station. The No-Action Alternative would not preserve a key park resource - the Outer Island Light Station.

Criterion 5—*Achieve a balance between population and resource use that will permit high standards of living and wide sharing of life's amenities.*

As visitation to Outer Island is expected to slowly increase indefinitely into the future, Alternative 2 best meets this criterion in terms of maintaining a key cultural resource for public enjoyment and education while minimizing adverse impacts on visitor boating safety, aesthetics, and the cultural landscape of Outer Island. The No-Action Alternative would eventually result in making the Outer Island Light Station area off-limits to all visitors because of safety hazards.

Criterion 6—*Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.*

In all of the action alternatives the construction crew would stay on Outer Island, eliminating the need for extra trips to the mainland and preserving fossil fuel resources. Alternative 2 focuses on constructing a revetment. Such a revetment would have less adverse impact on the bluff face in front of the light station and involves less construction into the lakebed compared to the other alternatives. These features of Alternative 2 translate into using fewer depletable resources while also preserving the existing environment. The No-Action Alternative would have no bearing on renewable or depletable resources.

4.0 AFFECTED ENVIRONMENT

Topics addressed in this section and subsequently analyzed in Section 5.0 (Environmental Consequences) were selected based on their relevance as indicated by on-site visits, secondary source documents, regulatory agency input, and information from APIS personnel.

4.1 Geology, Soils, and Topography

4.1.1 Geology

The area is part of the Mid-Continental Rift Geologic Province. APIS is underlain by three sandstone formations of the 2,600 foot thick Bayfield group (NPS, 1987). The Great Lakes, including Lake Superior, were sculpted by repeated glaciation, with the last glacier (Wisconsinan) retreating some 10,000 years ago. The Apostle Islands are primarily formed from glacial till overlying sandstone bedrock. The highest area on each island is usually on the north side as a result of glacial movement from northeast to the southwest.

4.1.2 Topography

The mean lake level within APIS is 602 feet IGLD 85. The topography of the islands is low rolling with the highest point being 1081 IGLD 85 on Oak Island. The range of elevation on Outer Island is from a low of about 613 feet IGLD at Sand Point (south tip of island) to a high point of more than 853 ft IGLD located on a central island rise. Record high lake levels during the mid-1980s increased the rates of erosion on all of the islands. Lake Superior levels are currently below the long-term average.

Erosion caused by wave action on the toe of slopes has resulted in development of steep banks on the north sides of most of the islands including Outer Island. The eroding banks along the northern and western sides of the islands are the source of material for development of beaches, sandspits, and tombolos on the south sides of many islands (NPS, 1987). Littoral drift of sand and sediments form beaches in protected bays and build sandspits off of the southern end of some islands. Tombolos are sandbars that form between and connect two islands or an island to the mainland (NPS, 1987).

Extensive shoals surround Outer Island. They extend the farthest into the lake along the northern and western sides of the island. Water levels less than 20 feet deep extend northward approximately ½ mile from the light station complex, and large submerged boulders are scattered throughout this area.

4.1.3 Soils

The banks adjacent to the Outer Island Light Station are composed of mixtures of clay, silty sand, and sandstone. As wave action removes sediment from the base of the slopes, the strength of the material above is insufficient to maintain stability resulting in slumping and slides, which combined with rill and sheetwash, cause continuing retreat of the bluff face (Mickelson and Edil, 1984). The 45 to 50-foot bluff in front of the Outer Island Light Station is composed of gravelly, sandy till of the Copper Falls Formation (Mickelson and Edil, 1984). There is no clay layer at the top of the bluff as there is at other islands. Some sandstone may occur at the base of the bluff; however, the extent of the sandstone layer is unknown (Mickelson and Edil, 1984). Since the bluff at Outer Island is partially composed of silty sand, the entire bluff is subject to

potential slips. A stable bluff top retreat of 30 to 50 feet, depending on groundwater conditions, would be necessary before the slope would become stable (Mickelson and Edil, 1984). The fog signal house is less than 70 feet from the edge of the bluff and it, as well as the lighthouse, is threatened by the projected amount of bluff top retreat. The historic progression of erosion along the bluff in front of the Outer Island Light Station can be seen in Figure 2.

Borings conducted by Wilhelm (1987) revealed a possible perched water table at a depth of 7.5 feet, 10 to 12 feet from the edge of the bluff and directly in front of the light station. The extent of the perched water table was not determined. There is a shallow, vegetated drainage ditch discharging at the top of the bluff southwest of the light station complex. This ditch partially drains a wetland area south of the station complex. The drainage was installed after studies in the 1980s indicated that the wetland area could be contributing to the perched water table and groundwater seeps along the face of the bluff in front of the light station. The bluff to which the ditch drains is very steep and highly eroded.

A slight surface depression is visible where a four foot-deep gravel-filled infiltration trench had been installed along the top of the slope running eastward from the tramway approximately 150 feet. Bluff erosion around the outfall pipe for this drainage ditch was more severe than erosion on adjacent portions of the bluff face. Erosion was also more evident around an abandoned gray water discharge pipe penetrating the bluff face in front of the lighthouse.

There are five old wooden retaining walls east of the tramway. To date, two of the five walls have completely failed. Park crews have completed minor, temporary repairs to these walls. The uppermost wall is undercut on the east side, and the wall immediately below it has been pushed forward. The remaining three walls have all shifted and show signs of failure. As the heavy riprap tapers off east of the tramway, it appears that slope erosion increases. The boulders making up the riprap were installed in the 1980s (DeGrosky, personal communication).

The concrete pier and breakwater, which was rebuilt in the 1930s, has evidently significantly slowed erosion immediately west of the tramway as evidenced by a build up of sand, gravel, and cobbles between the pier and the shoreline. There is also more mature tree cover on the slope immediately west of the tramway. Twenty to thirty-foot high birch with some very small hemlock are growing on the slope face with an understory of moss and grasses. None of the trees showed any recent signs of toppling or slippage. There was a narrow band of grasses and shrubs between the base of the wooded slope and the shoreline. Heavy rock riprap is in place from the concrete pier eastward, approximately 250 feet.

There was a 12-foot wide area of bluff that was impacted by a mass wasting event in 2001. The amount of sloughing associated with this event was enough to down a medium sized poplar tree (about 6" dbh and 20 foot high). According to park measurements, about 50 feet of bank exists between the tower of the light station and the edge of the bank (Pratt and Van Stappen, Personal Communication).

4.2 Water Quality

Water quality in APIS reflects the general oligotrophic (low nutrient) character of Lake Superior in general. There appears to be little impact from human activities on water quality within the Lakeshore. Rose (1988) reported on the water chemistry and benthic invertebrate fauna in some of the shallow water (0 to 80 feet deep) areas in APIS most highly used for recreational boating. Sampling sites used by Rose were in waters in Presque Isle Bay off Stockton Island and in the waters between Rock and South Twin. However, conditions in these areas were thought to be representative of shallow water areas throughout APIS islands.

Temperature stratification during the July sampling period occurred where the depth was greater than 10 feet. Surface and shallow water temperatures ranged from 62.6 to 66.2° F while deeper water temperatures ranged from 42.4 to 62.6° F. Oxygen was at or near saturation at all depths (Rose, 1988). Total phosphorus and organic carbon varied from <0.01 to 0.02 mg/L and 1.1 to 5.3 mg/L, respectively. These levels were similar to levels found in “deep water” monitoring sites (85 to 220 feet deep) within APIS, and indicate no adverse impact from human activities on and around the sampling sites (Rose, 1988). Mercury was not detected. Lake water is not currently used at this location and containerized potable water is provided to NPS volunteers on Outer Island.

4.3 Ecological Resources

4.3.1 Flora

Floristically, the archipelago is part of the hemlock/white pine/northern hardwoods forest, with a few boreal and sub-arctic elements (NPS, 1987). The area has a total of 803 plant species found in the vicinity of the lakeshore including the federally listed lake cress (*Armoracia lacustris*) and 37 state listed rare, threatened, or endangered species. As a result of historic logging activities, many of the island forests are dominated by white birch (*Betula papyrifera*), yellow birch (*Betula lutea*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), balsam fir (*Abies balsamea*), and white cedar (*Thuja occidentalis*) with limited stands of white pine (*Pinus strobus*) and hemlock (*Tsuga canadensis*) (NPS, 1987). Judziewicz and Koch (1993) provide a comprehensive discussion of Apostle Islands flora in their publication, Flora of the Apostle Islands.

Outer Island is one of the archipelago’s largest islands with an area of approximately 8,000 acres (Van Stappen and Kovar, 1987). The island has a diverse flora of 366 species (Judziewicz and Koch, 1993). Extensive logging of white pine and hemlock took place on the southern half of the island during the 1920s. More selective cutting of yellow birch and sugar maple took place in the northern portion of the island in the late 1940s and early 1950s. One area of virgin hemlock/hardwood forest of approximately 185 acres in size remains at the northwest corner of the island less than a mile southwest of the light station. This area was never logged because it was included in the government lighthouse reserve. This area is one of the finest tracts of virgin timber in the Great Lakes (Judziewicz and Koch, 1993). Large specimen trees of hemlock, yellow birch, sugar maple, and white pine dominate the forest canopy with yew (*Taxus canadensis*) and mountain maple (*Acer spicatum*) in the understory (Fraundorf, 1984). The light station complex is located in the upland opening cover type identified by Anderson and Milfred (1979).

Judziewicz and Koch classified the bluff area adjacent to the Outer Island Light Station as a clayscape plant community. Many introduced, as well as native weedy species, grow on the bluff. One specimen of the rare, special concern, Mingan moonwort (*Botrychium minganense*) has been conditionally identified in the eroding clay of the north coast bluffs. This species is not found in the project area. Also, grass-of-parnassus (*Parnassia palustris*), a state-listed threatened species, occurs along the clay bluffs of Outer Island on 35 to 50 degree slopes (Judziewicz, 1990). Island-wide populations of this species were surveyed in 1990, 1993 and 1996 (Judziewicz, 1996). Four local populations of the plant were identified in the vicinity of the light station complex. These small populations of plants, as apparently the case with all of the individual populations around the island, are very unstable from year to year. Populations of grass-of-parnassus are monitored by the NPS every five years (Van Stappen, 1999). A population of approximately 15 plants was observed growing by the light station stairs/tramway in 1990, but it had disappeared by 1996 (Judziewicz, 1996). An updated survey was completed

in 2001 and found that populations of grass-of-parnassus did not occur in the project area. Crowding by weedy species such as Canada blue grass (*Poa compressa*), reedtop grass (*Agrostis stolonifera*), white clover (*Trifolium repens*), and quaking aspen (*Populus tremuloides*) as well as ongoing erosion probably accounts for the instability of individual populations of this plant.

4.3.2 Fauna

Mammals known from Outer Island include deer mice (*Peromyscus maniculatus gracilis*), masked shrew (*Sorex cinereus*), meadow vole (*Microtus pennsylvanicus*), red squirrel (*Tamiasciurus hudsonicus*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethica*), weasel (*Mustela* sp.), snowshoe hare (*Lepus americanus*), coyote (*Canis latrans*), red bat (*Lasiurus borealis*), and little brown bat (*Myotis lucifugus*) (Anderson and Milfred, 1979). The notable absence of deer (*Odocoileus virginianus*) is responsible for some of the unique vegetation found on Outer Island, which has been destroyed by deer browsing in many other portions of APIS.

The greatest number of breeding bird species (104) recorded within the Apostle Islands was during 1977 (Temple and Harris, 1985). Migratory birds often concentrate in spring and fall on the sandspit of Outer Island. Migrant species transiting the Outer Island sand spit on the south side of the island have been monitored since 1990 (Smith, 1998). Bird species observed during a brief spring visit in the vicinity of the Outer Island Light Station by Anderson and Milfred (1979) are listed in Table 2. During the fall migration, Outer Island is a stopover point for one of the largest concentrations of peregrine falcons (*Falco peregrinus*) and merlins (*Falco columbarius*) in the upper Midwest (NPS, 1987). Peregrine falcons have just recently been removed from the federal endangered species list.

Table 2
Birds Observed in the Vicinity of the Outer Island Light Station

Common Name	Scientific Name
Great Blue Heron	<i>Ardea herodias</i>
American Woodcock	<i>Philohela minor</i>
Ruby-throated Hummingbird	<i>Archilochus colubris</i>
Black-capped Chickadee	<i>Poecile atricapillus</i>
Winter Wren	<i>Troglodytes troglodytes</i>
Yellow-rumped Warbler	<i>Dendroica coronata</i>
Mourning Warbler	<i>Oporornis philadelphia</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
American Tree Sparrow	<i>Spizella arborea</i>
Chipping Sparrow	<i>Spizella passerina</i>
Song Sparrow	<i>Melospiza melodia</i>
Dark-eyed Junco	<i>Junco hyemalis</i>
Brown-headed Cowbird	<i>Molothrus ater</i>
Purple Finch	<i>Carpodacus purpureus</i>
Note: Taxonomy as per AOU (1998).	

Bald eagle (*Haliaeetus leucocephalus*) nesting activity has historically occurred on Outer Island within 3/8 mile of the light station complex. Eagles used perching trees on both sides of the light station while feeding in the waters adjacent to the site (Van Stappen and Kovar, 1987). However, known former nest sites have not been utilized since 1994 (Van Stappen, personal communication). Currently, the bald eagle is a federal threatened species but is under review for

delisting. Cooper's hawks (*Accipiter cooperii*) have also historically nested on Outer Island. Ospreys (*Pandion haliaetus*) (state endangered) and red-shouldered hawks (*Buteo lineatus*) (state threatened) have been observed on Outer Island, but are not known to breed on the island (Van Stappen and Kovar, 1987). The federally endangered piping plover (*Charadrius melodus*) has been observed on the south side of Outer Island in the vicinity of the sandspit during migration. Suitable habitat for this species is not found in the vicinity of the light station.

Two species of reptiles—the eastern gartersnake (*Thamnophis sirtalis sirtalis*) and the red-bellied snake (*Storeia occipitomaculata*) and three species of amphibians—the blue-spotted salamander (*Ambystoma laterale*), spotted salamander (*Ambystoma maculatum*), and wood frog (*Rana sylvatica*) have been recorded in the vicinity of the Outer Island Light Station (as noted by Anderson and Milfred 1979) (cited in Van Stappen and Kovar, 1987).

As with other islands in APIS, the terrestrial invertebrates and aquatic macrobenthos of Outer Island have not been studied in detail. A seasonal fish refuge (September 1 through November 28) designated by the Wisconsin Department of Natural Resources extends northward from the Outer Island Light Station into Lake Superior and southwestward approximately two miles along the northwestern side of the island. This seasonal refuge extends westward from Outer Island to North Twin Island, South Twin Island, and the northern half of Cat Island. Fishing is not permitted in this important fish habitat area during the designated times of the year. A permanent, year-round refuge adjoins the seasonal refuge to the north and west.

4.4 Visitor Use and Experience

4.4.1 Visitation

Total FY 02 visitation to APIS Headquarters in Bayfield totaled 23,409. Total visitation to the Little Sand Bay Visitors Center was 8,346. In 2002, there were an estimated 935 visitors to Outer Island and 376 of those visitors toured the light station. Because of its remote location, visitation to Outer Island is almost entirely restricted to the summer season. The majority of visitors to APIS live in Wisconsin and Minnesota (especially the Twin Cities) with Illinois (Chicago area) a distant third (NPS, 1999). Although the vast majority of tourists visit the area during the summer months to participate in activities such as sightseeing, boating, fishing, hiking, nature study, camping, and kayaking, local businesses are working to increase tourism during the fall and winter months. There are opportunities for ice fishing, hunting, snowmobiling, skiing, and snowshoeing throughout the region.

Access to APIS is primarily by automobile using State Route 13, however Bay Area Travel Transit provides service for Bayfield, Washburn, Ashland, Red Cliff, and Odanah. In addition, the nearby Ashland Airport also services the region. Access to Outer Island is primarily by private boaters. The island is located 20 miles from Schooner Bay, 27 miles from Bayfield, 23 miles from Roys Point, and 39 miles from Washburn.

4.4.2 Tourism Based Economy

The local economy in Bayfield is focused on tourism-related outdoor recreational pursuits. The Wisconsin Department of Tourism listed Bayfield County as one of the top ten Wisconsin travel destinations in 1994. An estimated 70 million dollars was spent by tourists in Bayfield County in 1998 (WDT, 1999).

4.4.3 Experience and Activities

Access to Outer Island is made difficult due to the distance of the island from the mainland (an average of 27 miles) and the hazards of landing a boat during inclement weather, high winds, and rough water conditions. Concession cruise boats do not serve Outer Island except during the Lighthouse Celebration in September of each year, so visitation is generally restricted to those who use their own or rented watercraft or to those who use a water taxi service from the mainland. Access to the light station is primarily by using the concrete pier in front of the complex. However, a trail approximately 7 miles long bisects the island and connects the light station complex with the sandspit and a primitive campground at the south end of the island. A shorter (approximately 1.6 miles) trail, the Lullabye Trail connects the light station complex with a lake access point on the east side of the island.

A volunteer normally staffs the Outer Island Light Station during the summer months to provide interpretation, security, and grounds maintenance. In addition to the light station, visitors to Outer Island also can observe abandoned logging camps, beaver ponds, a stand of old-growth hemlock, an abandoned airstrip on the island, and a spectacular sandspit on the southern tip of the island.

Visitors come to the region primarily for outdoor, recreational opportunities. A number of activities take place throughout the lakeshore during the summer months. In addition, the Red Cliff and Bad River Band of Lake Superior Chippewa Reservations offer further recreational opportunities as does Big Bay State Park, located on Madeline Island.

4.5 Aesthetics

The enabling legislation establishing APIS charges the NPS with preserving the scenic aspects of the lakeshore. Scenic components of APIS include both the natural and built components of the area. Visitors to the historic light stations want to experience history through a combination of sights, sounds, and smells (Cartlidge, 1993). These visitors assign a high degree of importance to preservation of the views and natural elements associated with the light stations. Many visitors come to Outer Island to experience both the light station and the undeveloped areas of the island essentially managed as wilderness. Although important to the overall aesthetics of Outer Island, the undeveloped largely forested area of the island is not considered in this section. Viewsheds and general aesthetics of Outer Island are evaluated from both the lakeside and landside views.

The light station facilities at Outer Island have been a part of the Apostle Islands landscape for over 100 years. Erosion of the bluffs in front of these light stations has been a part of the landscape context of these sites since they were first constructed. Past attempts to slow or stop bluff erosion have included the installation of heavy riprap at Outer Island. The large riprap used at the site was chosen to blend in with the natural environment.

4.6 Cultural Resources

4.6.1 Archaeological Resources

Although direct evidence is limited, the prehistoric cultural sequence within the APIS follows the same general patterns observed for the eastern woodlands and the upper Great Lakes region (Green and Kehoe, 1986; Mason, 1981; Noble, 1993). The prehistoric sequence may be broken into three major periods, including the Paleoindian (11,000 to 7,000 BP), Archaic (8000 to 2000

BP), and Woodland periods (2000 to 500 BP). To date, no sites from any of these three periods have been found on Outer Island. Within the Terminal Woodland period (1300 to 500 BP) there are two distinct cultural groupings, known to archaeologists as the Blackduck and Sandy Lake cultures. The Blackduck peoples exploited wild rice to the point where they may have become the semi-sedentary antecedents of the historic Cree or Chippewa (Ojibwe). Less is known about the Sandy Lake people, known by a diagnostic ceramic ware. There is no evidence of either people on Outer Island.

Limited archaeological work occurred on Outer Island during the summer of 1975 and was concentrated on the southern end of the unit. While a minor surface survey was conducted on the north end of the island along the exposed bluff and beach area immediately adjacent to the lighthouse environs, intensive investigations were focused on the shoreline settings near the inland lake or captured lagoon and the interior regions adjacent to this area (Salzer and Overstreet, 1976). Salzer and Overstreet did not report any sites as a result of that survey.

Most recently, V. Noble visited Outer Island light station area in the late summer of 2000 to conduct a brief historic archaeological survey (Noble, 2000). Notable information from Noble's 2000 unpublished trip report is summarized in the following discussion.

An alignment of coursed brickwork, which was probably the remains of an earlier fog signal building and a concentration of historic trash just north of the brick work were observed. Both these features had been noted by Noble in an earlier visit to Outer Island (Noble, 1993). However, a column of coursed cobblestones near the brickwork, which was probably the remains of a cistern used to store water for the fog building, had apparently fallen into the lake as a result of bluff erosion between 1988 and 2000. Shovel tests along the bluff edge in front of the light station failed to reveal any cultural materials other than an isolated find of a ceramic cup fragment. Cultural resources notes in the shallow nearshore waters included cribbing that once supported an extension of the dock, some submerged iron tracks probably related to former Coast Guard boathouse operations, a machine radiator, and several coils of multi-strand cable partly embedded in cobblestones. Of greater interest was a submerged metal boiler that may have been associated with the original fog signal.

Noble's recommendations concerning documentation and preservation of these cultural materials included either leaving the metal boiler in place or carefully moving it away from any planned construction activity after consultation with the Midwest Archeology Center (MWAC) staff. It was also recommended that the boathouse tracks and the dock cribbing be recorded in place with reference to fixed points before they are removed or obscured by construction activities. The brickwork feature was recommended for protection from further damage prior to depositing stabilizing fill (Noble, 2000).

4.6.2 Cultural Resources (Historic Structures)

Previous investigators have divided the historic period at the APIS into two major periods (Early and Late) based upon dominant economic activities. The historic period is said to begin in the islands with the arrival of Groseilliers and Chouart at Chequamegon Bay in 1659 (Richner, 1987). This event marked the advent of the fur trade in the region, which dominated the region's economy until ca. 1820. Within the APIS, this period is represented by small fishing and hunting sites (47As47 and 47As40), although large village sites from the period are known on nearby Madeline Island (Richner, 1987).

The Late Historic period is characterized first by the decline of the fur trade and the advent of commercial fishing in western Lake Superior (1820-1855), and then by the explosive growth of various extractive industries dependent upon convenient bulk cargo shipping on the Great Lakes (1855-1910). Population and commerce boomed following the opening of the St. Mary's Falls Ship Canal (the Soo Locks) in 1855; one year later the first lighthouse was constructed on the Apostle Islands. Logging in various forms was an important extractive industry in the APIS area from the mid-1850s into the 1970s. Stockton, Hermit, and Basswood Islands were centers for the sandstone quarrying industry, with over 120 employees living on Basswood Island during the industry's heyday. Quarrying went into decline in the 1890s (Noble, 1993; Richner, 1987).

Light stations are the most visible historic resources in the APIS (Snyder, 1994), and are the focal points of island interpretation. The NPS will continue to maintain the light stations because of their historical significance (Snyder, 1994).

Following the APIS Building Survey of 1975, the Apostle Islands Lighthouses were listed as a thematic resource on the NRHP in 1977 (NPS, 1977). In 1990 the structures of the Outer Island Light Station were subject to HABS/HAER documentation (Beckett, 1990). This study, among others, document clear and overwhelming evidence for the historical significance of the structures associated with Outer Island Light Station.

To date, the NPS has created a structures inventory, a NRHP nomination, two limited project-specific Section 106 investigations, and HABS/HAER documentation, for the structures of the Outer Island Light Station (Beckett, 1990; Noble, 1993; NPS, 1977; Snyder 1994).

The standing structures at Outer Island Light Station currently include the lighthouse tower, the attached keeper's house, a brick privy, a brick oil locker, a clapboarded frame fog signal building, and the tramway/stairs/pier facilities. Additional features of the grounds include various cisterns, stand pipes and drains, a ladder rack, two flagpole stanchions, several fuel oil and propane tanks, modern visitor pit toilets, and unused tank stands (Gray and Pape, 2000). The fog signal building and the tramway, stairs, and pier are replacement structures for earlier facilities.

The Outer Island Lighthouse tower is of an Italianate style, with a focal plane 129 feet above Lake Superior. The lightkeeper's house is attached to the tower by a short passageway on the ground floor. The keeper's house is 2½ stories tall, with a clipped gable roof with side dormers, and arched 6/6 windows. A shed roof covers a single-story south ell, which houses the kitchen. Frame storm-porches were later attached to both west entrances to the keeper's house.

The lighthouse/keeper's house, fog signal building, oil locker, and privy were all explicitly listed as contributing elements to the historic property in the 1977 NRHP nomination. Due to changing standards of recordation and a growing appreciation of cultural landscapes as distinct from pristine examples of architectural styles, the remaining structures extant within the facility are now considered important contributing elements to the larger resource (Beckett, 1990).

4.6.3 Cultural Resources (Cultural Landscapes)

The NPS recognizes 13 character-defining elements to a cultural landscape, including natural systems and features, spatial organization, land use, cultural traditions, topography, vegetation, circulation, buildings and structures, cluster arrangement, views and vistas, constructed water features, small-scale features, and archaeological sites (Page, 1998). Although a formal cultural landscape inventory has not yet been completed, to date the NPS has completed a plan view for the HABS, the NRHP nomination, and several small archaeological investigations of the Outer

Island Light Station complex (Beckett, 1990; Noble, 1993; NPS, 1977). Due to its association with the historic theme of lighthouse stations as presented in the NRHP nomination, Outer Island Light Station is considered a cultural landscape under the category of historic sites. Insofar as these sites were modified over time to accommodate the domestic use of the keepers and their families, and the changing technologies inherent in their missions, they may also be considered historic vernacular landscapes (Birnbaum and Peters, 1996).

Historic maps of Outer Island Light Station are abundant and provide a visual history of development at the site. Observations of the light station during the mid-1990s note that the encroachment of vegetation is a serious change in the physical characteristics of the Outer Island lighthouse setting. Shoreline protection and various erosion control measures along the clay bluffs adjacent to the light station on Outer Island have been an integral part the historic landscape (Gray and Pape, 2000).

5.0 ENVIRONMENTAL CONSEQUENCES

This section of the EA forms the scientific and analytic basis for the comparisons of alternatives as required by 40 CFR 1502.14. This discussion of impacts (effects) is organized by resource area in parallel with Section 4.0 (Affected Environment). The No-Action Alternative and the action alternatives are discussed within each resource area. To the extent possible, the direct, indirect, short-term, long-term, beneficial, and adverse impacts of each alternative are described for each resource area.

5.1 Intensity, Duration, and Type of Impact

The evaluation of alternatives took into account whether the impacts would be negligible, minor, moderate, or major. Duration of impacts was evaluated based on the short or long-term nature of alternative-associated changes on existing conditions. More exact interpretations of intensity and duration are given for each resource area examined. Professional judgement is used to reach reasonable conclusions as to the intensity and duration of potential impacts. Type of impact refers to the beneficial or adverse consequences of implementing a given alternative.

5.2 Cumulative Impacts

The CEQ regulations, which implement NEPA, require an assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7).

Cumulative impacts are not discussed in this EA in the context of the definition given in 40 CFR 1508.7. The rationale for this is that the only past actions that pertain to possible action alternatives are the minor erosion control efforts (armor stone rip rap and wooden retaining walls at Outer Island). These existing structures would be removed with any of the action alternatives. Additionally, there are no other known planned future actions at Outer Island that would contribute to an analysis of cumulative impacts associated with the proposed action (erosion control).

5.3 Impairment Analysis

The NPS Management Policies (NPS, 2001) requires an analysis of potential effects to determine whether or not actions would impair the parks’ resources or values. The fundamental purpose of the NPS, as established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. The APIS enabling legislation, as amended, further mandates resource protection. NPS managers must always seek ways to avoid or minimize to the greatest degree practicable, actions that would adversely affect APIS resources and values.

These laws give NPS the management discretion to allow impacts to APIS resources and values when necessary and appropriate to fulfill the purposes of the park, so long as the impact does not constitute impairment of the affected resources and values. Although Congress has given NPS the management discretion to allow certain impacts within the park, that discretion is limited by the statutory requirement that NPS must leave the park resources and values unimpaired, unless a particular law directly and specifically provides otherwise.

A prohibited impairment is an impact that, in the professional judgement of the responsible NPS manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute impairment. Impairment may result from NPS activities in managing the park from visitor activities or from activities undertaken by concessionaires, contractors, and any other operators inside the park. Impairment of resources can also occur from activities outside APIS boundaries. An impact would be more likely to constitute impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park.
- Key to the natural or cultural integrity or to opportunities for enjoyment of the park.
- Identified as a goal in the park GMP/EIS or other relevant NPS planning documents.

A determination of impairment is made within this section, Environmental Consequences, under each alternative for geology, soils, topography, water quality, ecological resources (flora and fauna), and cultural resources (historic structures and cultural landscapes).

5.4 Impacts on Geology, Soils, and Topography

5.4.1 Methodology

Impact analysis focused on the effects of alternatives on bluff slope erosion in front of the light station, soil characteristics, shoreline topography, and littoral drift of suspended material around the island. General modifications to topography are also analyzed. Analysis is primarily qualitative since there are numerous factors such as details on acquiring, transporting, storing, and handling fill material; rapidity of vegetative re-establishment of reconfigured slopes; and success of erosion mitigation measures during construction in light of weather conditions that are currently non-quantifiable.

Basis of Analysis—

- **Bluff Erosion**—The impact analysis is discussed in terms of all forms of erosion occurring on the bluff slopes in front of the light station. These forms include sheet and rill erosion on the surface of the bluff face as well as periodic mass wasting events caused by wave action erosion along the toe of the existing slopes.
- **Shoreline Topography**—The impact analysis is discussed in terms of the alternatives modifying existing shoreline topography and nearshore water depths.
- **Littoral Drift**—Alternative impacts are qualitatively evaluated on their potential to change the movement of suspended materials along and around the island shorelines, which is an important part of the on-going geological processes responsible for formation and disintegration of sandbars and tombolos.

Intensity:

- **Negligible**—Imperceptible alterations to the light station bluff face including existing soils, general topography, and quantity or quality of littoral drift. Minor repairs to existing slope stabilization structures such as existing shoreline rip rap, which would be little noticed by visitors would be included in this intensity level.
- **Minor**—Limited, noticeable disturbance to the light station bluff face; soil disturbance (under one acre in total coverage) having some possible localized effects related to increased erosion potential or decreased erosion potential and littoral drift generation along

with and minimal changes to shoreline topography. This level of intensity could include any combination of the following: increased usage of current bluff face stabilization techniques and materials such as a substantial increase in rip rap placed along the shoreline, new wooden retaining walls along some portions of the bluff slope, limited revegetation efforts on the bluff slope, and possible limited bluff face reconfiguration using small equipment or hand tools.

- **Moderate**—Substantial changes in the light station bluff face with highly visible changes in soil conditions and shoreline topography. Noticeable and measurable changes in littoral drift quality and quantity would be associated with this level of intensity. Mitigative and/or remedial actions would be required for varying periods of time at this level of disturbance intensity.
- **Major**—Significant changes in the light station bluff face with large-scale changes in the character of existing soil conditions and topography that would possibly result in the impairment of park resources. Examples of this level of intensity would be catastrophic loss of bluff face soil stability resulting in the loss of cultural resource elements or the use of engineering techniques to stabilize the bluff slope that would significantly change the cultural resource value of the Outer Island Light Station.

Duration:

- **Short-Term**—Lasting only during the construction period or no longer than two years post-construction.
- **Long-Term**—Essentially a permanent post-construction impact.

5.4.2 No-Action Alternative

Analysis—

- **Bluff Erosion**—The No-Action Alternative at Outer Island would leave the existing large boulders (armor stone rip rap) along the shoreline. Although the NPS may continue small-scale, stopgap measures at slowing erosion along certain portions of the slope, erosional processes would proceed. The gravelly, silty sand soils on the bluff slope would continue to erode with a potential loss of 30 to 50 additional feet of bluff top before natural slope stabilization.
- **Shoreline Topography**—Shoreline topography would continue to be characterized by the armor stones bordering a shallow water area with a cobble and sand bottom. In the long-term, shoreline topography could be substantially altered. This could occur either through continued natural retreat of the toe of the slope through erosion and periodic outwashing of soil and rock behind the armor stones as a result of direct storm wave action and/or flanking around the edges of the existing armor stone. Any collapse of structures into the nearshore waters also would have an impact on shoreline topography.
- **Littoral Drift**—There would be a negligible impact on current littoral drift mechanisms, which are already somewhat impacted by the existing dock. No imported soil would be added to the face of the bluff under the No-Action Alternative. The No-Action Alternative would generally have a negligible impact on the historic geological processes within the Outer Island Light Station vicinity since it would allow a process that has been ongoing since the formation of Outer Island by the Wisconsin glaciation to continue. This process is part of the functioning ecosystems within the APIS, which includes maintenance of clayscape communities on the island bluffs, “feeding” of the littoral drift mechanism, and the slow, irregular addition of nutrient material into the oligotrophic waters surrounding the island.

Conclusion—The No-Action Alternative would have a negligible impact on the geologic conditions and processes associated with the bluff face of the Outer Island Light Station including bluff erosion, shoreline topography, and littoral drift.

Impairment—The No-Action alternative would not impair existing and on-going geologic, soil-associated, or topographic features characteristic of Outer Island.

5.4.3 Alternative 1 (Breakwater)

Analysis—

- **Bluff Erosion**—Alternative 1 would slow bluff erosion by modifying the existing slope to a stable configuration through the introduction of an estimated 8,000 to 9000 cubic yards of fill and an estimated 475 cubic yards of top soil brought from an NPS approved, but currently undetermined, mainland location. Alternative 1 would have moderate, short-term and long-term, adverse impacts on natural geological processes occurring along the bluff slope in front of the light station by slowing or stopping on-going erosion.
- **Shoreline Topography**—Alternative 1 would permanently modify the shoreline topography in the vicinity of the light station with the stabilized rebuilt bluff slope extending approximately 20 feet further into the lake from the current shoreline edge. In addition, the cobble beach (approximately at low water lake level of 601 feet IGLD 85) would extend from the toe of the rebuilt slope to the landward side of the breakwater structures. The breakwater structures themselves would permanently change shoreline and nearshore topography. The cobble beach would be exposed during low water levels such as those currently being experienced on Lake Superior. Shoreline topography would also be adversely impacted (when compared to natural island shorelines) at a moderate level in both the long term and short term by introduction of the various artificial changes associated with the breakwater itself as well as installation of the cobble beach.
- **Littoral Drift**—The amount of littoral drift would increase along with erosion during construction of this alternative, but could decrease after the fill materials have stabilized post-construction since the breakwater and cobble beach would trap more sediment/drift materials than is currently the case. This alternative would also result in a minor adverse and long-term impact on littoral drift resulting from movement and deposition of sand and sediment - particularly on the southern portion of the island in the vicinity of the sandspit.

Conclusion—Alternative 1 would have moderate, short-term and long-term, adverse impacts on bluff erosion and on shoreline topography. This alternative would have a long-term, minor, adverse impact on littoral drift.

Impairment—Although Alternative 1 would have some impact on the processes of bluff erosion and associated shoreline topography in the immediate vicinity of the Outer Island Light Station, preservation of the erosional process in this relatively small area would not be key to preserving examples of geologic processes or to public education about these processes within the park.

5.4.4 Alternative 2 (Revetment—Preferred Alternative)

Analysis—

- **Bluff Erosion**—Similar to Alternative 1, Alternative 2 would slow or halt bluff erosion by placing an estimated 8000 to 9000 cubic yards of fill and an estimated 475 cubic yards of topsoil would be added to the regraded and stabilized slope. This alternative would temporarily increase erosion during construction, but would decrease bluff erosion in the long-term. Alternative 2 would have minor, long-term, adverse impacts on geological processes occurring along the bluff slope in front of the light station by slowing or stopping on-going erosion.
- **Shoreline Topography**—Shoreline topography in front of the light station would be permanently modified with a relatively uniform layered armor stone revetment rising approximately four feet (depending on lake levels) above the Lake Superior waterline. As a result, natural shoreline topography would be adversely impacted at a minor level in both the long term and short term by introduction of the various artificial changes associated with the revetment.
- **Littoral Drift**—Alternative 2 would temporarily increase littoral drift during construction, but would slightly decrease overall island littoral drift generation in the long-term. The underwater toe of the revetment could trap a slightly greater amount of littoral drift in the vicinity of the light station than does the currently existing shoreline and pier/breakwater, but this alternative would have an overall negligible impact on littoral drift resulting from movement and deposition of sand and sediment.

Conclusion—Alternative 2 would have minor, long-term adverse impacts on bluff erosion; minor short-term and long-term, adverse impacts on shoreline topography, and negligible impacts on littoral drift.

Impairment—Although Alternative 2 would have some impact on the processes of bluff erosion and associated shoreline topography in the immediate vicinity of the Outer Island Light Station, preservation of the erosional process in this relatively small area would not be key to preserving examples of geologic processes or to public education about these processes within the park.

5.4.5 Alternative 3 (Islands)

Analysis—

- **Bluff Erosion**—This alternative would include the addition of approximately 8,000 cy of fill to the bluff slope with roughly another 8,000 cy of soil and fill used to construct the series of small islands 50-90 feet offshore. As with the other action alternatives, implementation of Alternative 3 would slow or stop the natural erosion process of the bluff slope in front of the light station. Also, as with all the action alternatives, Alternative 3 would temporarily increase erosion along the bluff slope during the construction and before permanent slope stabilization. Alternative 3 would have minor, long-term, adverse impacts on geological processes occurring along the bluff slope in front of the light station by slowing or stopping on-going erosion.
- **Shoreline Topography**—Alternative 3 would permanently modify the shoreline topography in the vicinity of the light station with the stabilized rebuilt bluff slope extending approximately 20 feet further into the lake from the current shoreline edge. In addition, the cobble beach (approximately at low water lake level of 601 feet IGLD 85) would extend from the toe of the rebuilt slope to the landward side of the artificial islands.

The islands themselves would permanently change shoreline and nearshore topography. The cobble beach would be exposed during low water levels such as those currently being experienced on Lake Superior. Shoreline topography would also be adversely impacted (when compared to natural island shorelines) at a moderate level in both the long term and short term by introduction of the various artificial changes associated with the islands as well as installation of the cobble beach.

- **Littoral Drift**—The amount of littoral drift would increase along with erosion during construction of this alternative, but could decrease after the fill materials have stabilized post-construction. Since the islands and cobble beach would trap more sediment/drift materials than is currently the case, there could be minor adverse and long-term impacts on littoral drift movement and deposition of sand and sediment. However, some soil erosion may continue to occur indefinitely from the landside of the constructed islands and contribute to littoral drift, which could mitigate any changes in overall volume of littoral drift.

Conclusion—Alternative 3 would a minor long-term adverse impact on erosion; a short-term and long-term moderate adverse impact on natural island shoreline topography; and a long-term minor, adverse impact on littoral drift

Impairment—Although Alternative 3 would have some impact on the processes of bluff erosion and associated shoreline topography in the immediate vicinity of the Outer Island Light Station, preservation of this erosional process in this relatively small area would not be key to preserving examples of geologic processes or to public education about these processes within the park.

5.4.6 Alternative 4 (Submerged Breakwater with Revetment)

Analysis—

- **Bluff Erosion**—The slope would be reconfigured through the introduction of an estimated 6000 to 6500 cubic yards of fill materials soil brought from an NPS approved, but currently undetermined, mainland location. Alternative 4 would greatly reduce or halt geologic erosional processes on the bluff slope in front of the Outer Island Light Station. The combined revetment and submerged breakwater would have long-term, minor, adverse impacts on existing geological processes of bluff erosion.
- **Shoreline Topography**—Alternative 4 would permanently modify the shoreline topography in the vicinity of the light station with the stabilized rebuilt bluff slope extending approximately 20 feet further into the lake from the current shoreline edge, however, the four foot-high revetment would blend in with the existing shoreline topography. The breakwater structures themselves would permanently change shoreline and nearshore topography. Shoreline topography would also be adversely impacted (when compared to natural island shorelines) at a moderate level in both the long term and short term by introduction of the various artificial changes associated with the breakwater itself.
- **Littoral Drift**—This alternative would also have a long-term, minor, adverse impact on the movement of littoral drift already in the waters adjacent to the light station since the combination of breakwater and revetment would trap additional drift materials.

Conclusion—Alternative 4 would have a long-term, minor adverse impact on erosion; short-term and long-term, moderate, adverse impact on shoreline topography; and a minor, long-term, adverse impact on littoral drift.

Impairment—Although Alternative 4 would have some impact on the processes of bluff erosion and associated shoreline topography in the immediate vicinity of the Outer Island Light Station, preservation of the erosional process in this relatively small area would not be key to preserving examples of geologic processes and public education about these processes within the park.

5.5 Impacts on Water Quality

5.5.1 Methodology

Impact analysis focused on the amount of fill materials (soil and stone) placed directly into nearshore waters, disturbance of the natural lake bottom during construction, and the potential for petroleum product contamination of waters during construction activities. Although site plans provide guidance, some details of construction are not yet known, therefore some of the analysis is qualitative and based on professional judgement.

Basis of Analysis—

- **Quantity and Placement of Fill Material into Lake Superior Waters**—The impact analysis is discussed in terms of the estimated quantity of fill and other materials placed into Lake Superior waters. Fill in Lake Superior waters is defined as the amount of material placed at or below 602 feet IGLD 85, which is considered waters of the State of Wisconsin.
- **Disturbance of the Lake Bottom**—The impact analysis is discussed in terms of the potential disturbance of existing lake-bottom by equipment used in the construction process and by placement of structural materials into the lake.
- **Potential for Contamination**—Alternative impacts are qualitatively discussed in terms of possible equipment-associated contamination of nearshore waters.

Intensity:

- **Negligible**—Any changes in water quality, such as increased turbidity or changes in any contaminant level, that would be detectable using water quality instrumentation, but would be undetectable visually and would leave water quality within those limits defining a relatively pristine oligotrophic water body.
- **Minor**—Changes in water quality would be measurable with instrumentation and would be noticeable. However, any changes in turbidity and/or contamination would be temporary and localized near construction operations. Long-term changes in lake bottom disturbance through placement of fill materials would extend no more than 30 feet into the lake from the existing island shoreline (i.e., no further than the toe of a reconfigured 2:1 slope). Mitigation measures to minimize water quality impacts would be necessary.
- **Moderate**—Changes in water quality would be measurable with instrumentation and would be highly noticeable particularly during construction. Turbidity and/or contamination would be temporary but of longer duration than with a minor level of impact. Long-term changes in lake-bottom disturbance through placement of fill materials would extend more than 30 feet into the lake from the existing island shoreline. Mitigation measures to minimize water quality impacts would be necessary.
- **Major**—Changes in water quality would be significant in terms of the extent and duration of increasing turbidity, sedimentation, and (possibly) contamination. Changes would be long-term or permanent in duration resulting in changes in the suitability of nearshore waters for current uses as aquatic organism habitat. Long-term changes in lake-bottom disturbance through placement of fill materials would extend more than 30 feet into the lake

from the existing island shoreline. Mitigation measures to minimize water quality impacts would be necessary.

Duration:

- **Short-Term**—Lasting only during the construction period or no longer than two years.
- **Long-Term**—Essentially a permanent post-construction impact.

5.5.2 No-Action Alternative

Analysis—

- **Quantity and Placement of Fill**—The No-Action Alternative involves no placement of fill in the lake and would leave nearshore water quality unchanged from its current high quality condition. Low volumes of sediment would continue to enter the waters at the base of the bluff slope in front of the light station as a result of continued weathering and erosion. Occasionally greater amounts of sediment may enter the water after a mass wasting event or other larger erosion event on the slope.
- **Disturbance of the Lake Bottom**—In this alternative, the lake bottom near the island would remain undisturbed except as the result of low levels of human activity associated with on-going park operations and visitors' watercraft.
- **Potential for Contamination**—The No-Action Alternative would involve some potential minor contamination of the nearshore waters associated with watercraft docking and operations

Conclusion—The No-Action Alternative would have a negligible impact on nearshore waters adjacent to Outer Island Light Station.

Impairment—There would be no impairment of park water resources with this alternative.

5.5.3 Alternative 1 (Breakwater)

Analysis—

- **Quantity and Placement of Fill**—Alternative 1 would involve placement of soil and other material (filter stone, core stone, and armor stone) directly into the waters of Lake Superior (defined as below 602 feet IGLD 85) to construct the breakwater. In addition, the creation of a cobble beach would increase the total amount of materials placed into Lake Superior. The fill would extend 25 feet lakeward from the existing shoreline. This alternative would result in an increase in suspended sediment within the waters adjacent to the light station during and immediately after construction. The placement of cobble, core stone, filter stone, and armor stone could contain some of the suspended sediment from the fill, reducing the impacts of introducing such a quantity of material into Lake Superior. In addition to fill materials purposely placed in the water, increased sediments may also be generated from erosion off of the unvegetated slope during and shortly following bluff slope regrading. Sediment may also originate from fill materials stockpiled on barges near the work site.

- **Disturbance of the Lake Bottom**—Construction of the breakwater in this alternative could disturb the lake bottom up to 75 feet offshore due to equipment use and transport/placement of materials. Construction of a means for barge access to the island could also disturb portions of the nearshore lake bottom through any one or a combination of limited channel dredging, placement of temporary fill, and use of pontoon anchoring. Although the cobble, core stone, filter stone, and armor stone used in construction of the actual breakwater would probably generate less suspended sediment than soil fill, this benefit during construction might be offset by the disturbances resulting from in-water equipment use in construction of the breakwater. The methodology used in placing the fill and stone materials would follow BMPs and would be permitted under the authority of the State of Wisconsin, the Army Corps of Engineers, and the U.S. Coast Guard. However, there would be no way to prevent temporarily increasing sediment generation and disturbance.
- **Potential for Contamination**—Contamination of the waters of Lake Superior could come from several sources in this alternative. Sources of sediment (erosion from the bluff slope and escaping from material staging barges) could locally contaminate the waters of Lake Superior. Construction of Alternative 1 would involve more equipment operation within the waters of Lake Superior to place and form erosion control structures. This would increase the potential for petroleum product contamination of the water from the equipment.

Conclusion—Alternative 1 would have a moderate, short-term, adverse impact on nearshore water quality in the vicinity of the Outer Island Light Station.

Impairment—The localized, short-term impacts of this alternative on nearshore water quality in the vicinity of the Outer Island Light Station would not constitute a substantive impairment of park water quality within the definition of NPS Management Policies.

5.5.4 Alternative 2 (Revetment—Preferred Alternative)

Analysis—

- **Quantity and Placement of Fill**—Alternative 2 would involve the least amount of fill placed directly into the water. This alternative would involve placement of an estimated 3000 cubic yards of soil and other material (filter stone and armor stone) directly into the waters of Lake Superior (defined as areas below 602 feet IGLD 85). Construction would create moderate amounts of suspended sediment until construction was complete and all fill materials stabilized. In addition to fill materials purposely placed in the water, increased sediments may also be generated from erosion off of the unvegetated slope during and shortly following bluff slope regrading. Sediment may also originate from fill materials stockpiled on barges near the work site.
- **Disturbance of the Lake Bottom**—There is the possibility that dredging the lake bottom could occur with this alternative in order to “toe-in” the revetment. If dredging does occur it would result in short-term increases of suspended sediment and a decrease in water quality. Construction of a means for barge access to the island could also disturb portions of the nearshore lake bottom through any one or a combination of limited channel dredging, placement of temporary fill, and use of pontoon anchoring. The methodology used in placing the fill and stone materials would follow BMPs and would be permitted under the authority of the State of Wisconsin, the Army Corps of Engineers, and the U.S. Coast Guard. However, there would be no way to prevent temporarily increasing sediment generation and disturbance.
- **Potential for Contamination**—Localized, short-term contamination of the nearshore waters could occur from sediment eroding from fill materials stockpiled on barges near the work site and from erosion off the regraded slope. Although unquantifiable, the presence of

construction equipment on site would present the possibility of additional limited contamination of nearshore waters with petroleum products.

Conclusion—Alternative 2 would have a moderate, short-term, adverse impact on nearshore water quality in the vicinity of the Outer Island Light Station, though less than all other action alternatives since there would be less actual in-water work.

Impairment—The localized, short-term impacts of this alternative on nearshore water quality in the vicinity of the Outer Island Light Station would not constitute a substantive impairment of park water quality within the definition of NPS Management Policies.

5.5.5 Alternative 3 (Islands)

Analysis—

- **Quantity and Placement of Fill**—Alternative 3 would involve placement of an estimated 7600 cubic yards of soil and other material (filter stone, cobble, and armor stone) directly into the waters of Lake Superior (defined as areas below 602 feet IGLD 85). The placement of cobble beach, armor stone, and filter stone could contain some of the suspended sediment from the fill, reducing the impacts of introducing such a quantity of material into Lake Superior. In addition, the soil and stone mixture on the landside of the artificial islands would be a potential long-term source of additional sediment generation after the completion of construction activities. Qualitatively, it would seem that this alternative has the greatest potential to increase sediment in the waters adjacent to the light station for a prolonged period of time. In addition to fill materials purposely placed in the water, increased sediments may also be generated from erosion off of the unvegetated slope during and shortly following bluff slope regrading. Sediment may also originate from fill materials stockpiled on barges near the work site.
- **Disturbance of the Lake Bottom**—This alternative would result in the most bottom disturbance from equipment operation and construction of any of the action alternatives at Outer Island. Construction of a means for barge access to the island could also disturb portions of the nearshore lake bottom through any one or a combination of limited channel dredging, placement of temporary fill, and use of pontoon anchoring. Construction of the islands and cobble beach would decrease water quality in the short-term. The methodology used in placing the fill and stone materials would follow BMPs and would be permitted under the authority of the State of Wisconsin, the Army Corps of Engineers, and the U.S. Coast Guard. However, there would be no way to prevent temporarily increasing sediment generation and disturbance.
- **Potential for Contamination**—This alternative would involve more construction in the waters of the lake further from shore, increasing the potential for petroleum product contamination from equipment.

Conclusion—Alternative 3 would have a moderate, short-term, adverse impact on nearshore water quality and minor, long-term, adverse impact on nearshore water quality in the vicinity of the Outer Island Light Station.

Impairment—The localized, short-term impacts of this alternative on nearshore water quality in the vicinity of the Outer Island Light Station would not constitute a substantive impairment of park water quality within the definition of NPS Management Policies.

5.5.6 Alternative 4 (Submerged Breakwater with Revetment)

Analysis—

- **Quantity and Placement of Fill**—Alternative 4 would involve placement of an estimated 5000 cubic yards of soil and other material (filter stone and armor stone) directly into the waters of Lake Superior (defined as below 602 feet IGLD 85). In addition to fill materials purposely placed in the water, increased sediments may also be generated from erosion off of the unvegetated slope during and shortly following bluff slope regrading. Sediment may also originate from fill materials stockpiled on barges near the work site. The placement of cobble, core stone, filter stone, and armor stone could contain some of the suspended sediment from the fill, reducing the impacts of introducing such a quantity of material into Lake Superior.
- **Disturbance of the Lake Bottom**—This alternative includes the direct addition of materials into the water along with bottom disturbance from construction equipment operations would create moderate amounts of suspended sediment until construction was complete and all materials stabilized. Construction of a means for barge access to the island could also disturb portions of the nearshore lake bottom through any one or a combination of limited channel dredging, placement of temporary fill, and use of pontoon anchoring. Although the cobble, core stone, filter stone, and armor stone would probably generate less suspended sediment than soil fill, this benefit during construction could be offset by the disturbances resulting from in-water equipment use in construction of the breakwater. The methodology used in placing the fill and stone materials would follow BMPs and would be permitted under the authority of the State of Wisconsin, the Army Corps of Engineers, and the U.S. Coast Guard. However, there would be no way to prevent temporarily increasing sediment generation and disturbance.
- **Potential for Contamination**—Although unquantifiable, the presence of construction equipment on site would present the possibility of additional limited contamination of nearshore waters with petroleum products. Any damage from this type of contamination would be minimized through the use of containment structures such as absorbent booms. Sources of sediment (erosion from the bluff slope and escaping from material staging barges) could also locally contaminate the waters of Lake Superior.

Conclusion—Alternative 4 would have a moderate, short-term adverse impact on nearshore water quality in the vicinity of the Outer Island Light Station.

Impairment—The localized, short-term impacts of this alternative on nearshore water quality in the vicinity of the Outer Island Light Station would not constitute a substantive impairment of park water quality within the definition of NPS Management Policies

5.6 Impacts on Ecological Resources (Flora)

5.6.1 Methodology

Impact analysis focused on the clayscape communities and endangered species existing on the bluff slopes in front of the light station and on the littoral communities within the nearshore waters adjacent to the light station.

Basis of Analysis—

- **Clayscape Disturbance**—Alternative impacts are evaluated based on the extent of disturbance to the overall clayscape community existing on Outer Island.

- **Littoral Disturbance**—The impact analysis is discussed in terms of disturbance to the shallow water/shoreline/littoral community surrounding Outer Island.
- **Endangered Species Impacts**—Alternative impacts are evaluated based on the disturbance and/or removal of state or federal threatened or endangered plants.

Intensity:

- **Negligible**—Changes in the clayscape community would occur only at a level detectable through detailed biological survey capable of locating individual plant specimens or populations (*i.e.*, visitors and casual observers would not detect visual changes in the clayscape community). Similarly, subtle changes in the population dynamics of nearshore littoral community components (vascular plants as well as phytoplankton) would occur, but would not normally be noticeable. Although changes in local abundance of federal or state-listed species may occur, general abundance would not change.
- **Minor**—Changes in the clayscape community would occur at a level detectable to some visitors and casual observers. These changes would be localized to small areas on the bluff slope and would be associated with installation of additional relatively low-intensity methods of erosion control, *e.g.* additional retaining walls, shoreline rip rap, etc. Some plant specimens could be destroyed or moved as part of these efforts. Changes in the population dynamics of nearshore littoral community components (vascular plants as well as phytoplankton) would not be noticeable. Direct or indirect impacts to small populations or individual specimens of federal or state-listed species could occur and would require mitigation.
- **Moderate**—Substantial changes in the clayscape community would occur at a level noticeable by any visitor and would involve most or all of the bluff slope in front of the light station. Any plants in the area of disturbance would be displaced or destroyed. Changes in the population dynamics of nearshore littoral community components would be noticeable but temporary during construction disturbance, and mitigative measures would be required to minimize impacts to aquatic species. Direct or indirect impacts to small populations or individual specimens of federal or state-listed species would occur and would require mitigation.
- **Major**—Substantial changes in the clayscape community would occur at a level noticeable by any visitor and would involve most or all of the bluff slope in front of the light station. Most, if not all, plants in the area of disturbance would be displaced or destroyed. Changes in the population dynamics of nearshore littoral community components would be noticeable and would be permanent. Mitigative measures would be required to minimize impacts to aquatic species. Direct or indirect impacts to significant portions of populations of federal or state-listed species would occur and would require extensive mitigation.

Duration:

- **Short-term**—Lasting only during the construction period or no longer than two years.
- **Long-term**—Essentially a permanent post-construction impact.

5.6.2 No-Action Alternative

Analysis—

- **Clayscape Disturbance**—The No-Action Alternative would allow the existing clayscape community in front of the Outer Island Light Station to remain largely undisturbed with the exception of possible small, stopgap measures at erosion control implemented by the NPS. Otherwise, the dynamics of erosion and plant succession would be allowed to continue.

- **Littoral Disturbance**—The littoral community in nearshore waters adjacent to the light station would remain essentially undisturbed by the No-Action Alternative.
- **Endangered Species Impacts**—The No-Action Alternative would have no impact on any populations federal or state-listed species, including the state threatened grass-of-parnassus that may exist on the bluff slope in front of the light station.

Conclusion—The No-Action Alternative would have a negligible impact on the clayscape community, littoral community, and endangered species associated with Outer Island.

Impairment—There would be no impairment of park botanical resources with this alternative.

5.6.3 Alternative 1 (Breakwater)

Analysis—

- **Clayscape Disturbance**—The grading and fill activities associated with this alternative would destroy the existing clayscape community directly in front of the light station. However, the loss of this small portion of clayscape community would be minor in the context of the overall size of the clayscape community on Outer Island. Prior to construction, NPS would implement mitigation measures that would involve collecting cuttings and seed material from existing Apostle Island clayscape plants. This material would be used to propagate at least some of the plants used in revegetating the regraded slope. Following construction, the regraded slope may be stabilized using several rows of facines interplanted with native herbaceous species and grasses.
- **Littoral Disturbance**—The planktonic flora of the littoral community adjacent to the construction site would be disturbed during construction activities, but would recover after completion of the project. Construction of a cobble beach on the landside of the breakwater would also have a direct minor adverse impact on some components of the littoral communities. However, the additional underwater structure provided by the breakwater could have a long-term, minor, beneficial impact on other components of the littoral community such as periphyton or aufwuchs.
- **Endangered Species Impacts**—The fill used to treat the bluff slope in this alternative would destroy the existing clayscape community directly in front of the Light Station. Although the most recent survey (NPS, 2001) found no state threatened grass-of-paranassus (*Parnassia palustris*) in the project area, the area will be resurveyed prior to construction. If any plants are found, they will be moved to suitable habitat on the northern end of Outer Island.

Conclusion—Alternative 1 would have a long-term, minor, adverse impact on the clayscape plant community. This alternative would also possibly have a long-term and short-term, minor, adverse impact on some components of the littoral community. However, it would also possibly have a long-term, minor, beneficial impact on other littoral flora by providing additional underwater habitat. There would be a negligible impact on endangered species.

Impairment—The highly localized destruction of clayscape flora associated with this alternative coupled with the abundance of the clayscape community on Outer Island and elsewhere within APIS would not constitute a substantive impairment of park botanical resources within the definition of NPS Management Policies.

5.6.4 Alternative 2 (Revetment—Preferred Alternative)

Analysis—

- **Clayscape Disturbance**—The grading and fill activities associated with this alternative would destroy the existing clayscape community directly in front of the light station. However, the loss of this small portion of clayscape community would be minor in the context of the overall size of the clayscape community on Outer Island. Prior to construction, NPS would implement mitigation measures that would involve collecting cuttings and seed material from existing Apostle Islands clayscape plants. This material would be used to propagate at least some of the plants used in revegetating the regraded slope. Following construction, the regraded slope may be stabilized using several rows of facines interplanted with native herbaceous species and grasses.
- **Littoral Disturbance**—Alternative 2 would have somewhat less of an impact on the littoral community than Alternative 1 since there would be less in-water work needed to build the revetment, and the work would be more confined to the shoreline than is the case when constructing breakwaters. There would still be short-term construction-related impacts on the littoral zone. However, given less structure placed in the littoral zone, Alternative 2 would probably have an overall negligible impact on the littoral community.
- **Endangered Species Impacts**—The long-term loss of habitat for the grass-of-parnassus would be minor in context of the overall size of the clayscape community. This alternative would have a negligible impact on plant components of the littoral community. Although the most recent survey (NPS, 2001) found no state threatened grass-of-parnassus (*Parnassia palustris*) in the project area, the area will be resurveyed prior to construction. If any plants are found, they will be moved to suitable habitat on the northern end of Outer Island.

Conclusion—Alternative 2 would have a long-term, minor adverse impact on the clayscape plant community. This alternative would have an overall negligible impact on the littoral community and on endangered species.

Impairment—The highly localized destruction of clayscape flora associated with this alternative coupled with the abundance of the clayscape community on Outer Island and elsewhere within APIS would not constitute a substantive impairment of park botanical resources within the definition of NPS Management Policies.

5.6.5 Alternative 3 (Islands)

Analysis—

- **Clayscape Disturbance**—The grading and fill activities associated with this alternative would destroy the existing clayscape community directly in front of the light station. However, the loss of this small portion of clayscape community would be minor in the context of the overall size of the clayscape community on Outer Island. Prior to construction, NPS would implement mitigation measures that would involve collecting cuttings and seed material existing Apostle Islands clayscape plants. This material would be used to propagate at least some of the plants used in revegetating the regraded slope. Following construction the regraded slope may be stabilized using several rows of facines interplanted with native herbaceous species and grasses.
- **Littoral Disturbance**—The vascular and planktonic flora of the littoral community adjacent to the construction site would be disturbed during construction activities, but would recover after completion of the project. Construction of a cobble beach on the landside of the constructed islands would also have a direct minor adverse impact on some

components of the littoral communities. However, the additional underwater structure provided by the breakwater could have a long-term minor beneficial impact on other components of the littoral community such as periphyton or aufwuchs.

- **Endangered Species Impacts**—Although construction of the islands would not directly affect the clayscape community, the regrading of the bluff slope would have a substantial impact. This alternative would entail the destruction of any plants growing on the slope, including any specimens of the threatened grass-of-parnassus. Although the most recent survey (NPS, 2001) found no state threatened grass-of-parnassus (*Parnassia palustris*) in the project area, the area will be resurveyed prior to construction. If any plants are found, they will be moved to suitable habitat on the northern end of Outer Island.

Conclusion—Alternative 3 would have a long-term, minor adverse impact on the clayscape plant community. This alternative would have a short-term and long-term, minor adverse impact on some species of the littoral plant community, while it may also have a long-term, minor beneficial impact by providing additional underwater habitat for other littoral species. There would be a negligible impact on endangered species.

Impairment—The highly localized destruction of clayscape flora associated with this alternative coupled with the abundance of the clayscape community on Outer Island and elsewhere within APIS would not constitute a substantive impairment of park botanical resources within the definition of NPS Management Policies.

5.6.6 Alternative 4 (Submerged Breakwater and Revetment)

Analysis—

- **Clayscape Disturbance**— The grading and fill activities associated with this alternative would destroy the existing clayscape community directly in front of the light station. However, the loss of this small portion of clayscape community would be minor in the context of the overall size of the clayscape community on Outer Island. Prior to construction, NPS would implement mitigation measures that would involve collecting cuttings and seed material existing Apostle Islands clayscape plants. This material would be used to propagate at least some of the plants used in revegetating the regraded slope. Following construction the regraded slope may be stabilized using several rows of facines interplanted with native herbaceous species and grasses.
- **Littoral Disturbance**—The vascular and planktonic flora of the littoral community adjacent to the construction site would be disturbed during construction activities, but would recover after completion of the project. Construction of submerged breakwater would also have a direct minor adverse impact on some components of the littoral communities. However, the additional underwater structure provided by the breakwater could have a long-term minor beneficial impact on other components of the littoral community such as periphyton or aufwuchs.
- **Endangered Species Impacts**—Alternative 4 would result in the total loss of the existing clayscape community on the bluff slope in front of the Outer Island Light Station. Although a recent survey (NPS, 2001) found no grass-of-parnassus plants in the project area, another survey will be conducted prior to construction. If any of these plants are found, they will be transplanted to suitable habitat elsewhere on the northern portion of Outer Island.

Conclusion—Alternative 4 would have a long-term, minor adverse impact on the clayscape plant community. This alternative would have a short-term and long-term, minor adverse impact on some species of the littoral plant community, while it may also have a long-term, minor beneficial impact by providing additional underwater habitat for other littoral species. There would be a negligible impact on endangered species.

Impairment—The highly localized destruction of clayscape flora associated with this alternative coupled with the abundance of the clayscape community on Outer Island and elsewhere within APIS would not constitute a substantive impairment of park botanical resources within the definition of NPS Management Policies.

5.7 Impacts on Ecological Resources (Fauna)

5.7.1 Methodology

Impact analysis focused on the fauna existing in the clayscape community in front of the light station and on the littoral communities within the nearshore waters adjacent to the light station.

Basis of Analysis—

- **Clayscape Disturbance**—Alternative impacts are evaluated based on the extent of disturbance to the clayscape faunal community on Outer Island.
- **Littoral Disturbance**—The impact analysis is discussed in terms of disturbance to the shallow water/shoreline/littoral faunal community surrounding Outer Island.
- **Endangered Species Impacts**—Alternative impacts are evaluated based on the disturbance and/or removal of state or federal threatened or endangered fauna.

Intensity:

- **Negligible**—Disturbance of native terrestrial or aquatic faunal communities would be highly limited in both extent and duration and would result from very localized temporary human disturbance. Most faunal species temporarily disturbed by activity would return to basically unchanged habitat within a few hours or days of disturbance. Federal or state-listed species would not be impacted nor would game fish species be impacted.
- **Minor**—Disturbance of native terrestrial or aquatic fauna would be limited in extent, but would result in a permanent change in local distribution as a result of habitat change. Game fish and federal or state-listed species would not be impacted.
- **Moderate**—Disturbance of native terrestrial or aquatic fauna would be limited in extent, but would result in a permanent change in local distributions as a result of habitat change. Federal or state-listed species could be impacted, as could game fish species.
- **Major**—Disturbance of native terrestrial or aquatic fauna would be widespread in extent, and would result in a permanent change in local distributions as a result of habitat change. Federal or state-listed species would be impacted as well as game fish species. Mitigation would be required.

Duration:

- **Short-term**—Lasting only during the construction period or no longer than two years.
- **Long-term**—Essentially a permanent post-construction impact.

5.7.2 No-Action Alternative

Analysis—

- **Clayscape Disturbance**—The No-Action Alternative would allow the existing faunal components of the clayscape community adjacent to the activities associated with the Outer Island Light Station to remain largely undisturbed with the exception of actions associated with small, stopgap erosion control measures.
- **Littoral Disturbance**—The littoral community in nearshore waters adjacent to the light station would remain essentially undisturbed by this alternative.
- **Endangered Species Impacts**—The No-Action Alternative would have no impact on populations of state or federal-listed animal species.

Conclusion—The No-Action Alternative would have a negligible impact on the terrestrial and aquatic fauna in the vicinity of the Outer Island Light Station. There would be no impact on state or federal-listed faunal species or on game fish populations.

Impairment—There would be no impairment of park faunal resources with this alternative.

5.7.3 Alternative 1 (Breakwater)

Analysis—

- **Clayscape Disturbance**—The fill used to treat the bluff slope in this alternative and associated construction activities would destroy habitat for terrestrial fauna existing within the clayscape directly in front of the light station. However, similar habitat and terrestrial faunal communities are found in several locations around Outer Island. The short-term loss/relocation of terrestrial fauna within this portion of the clayscape community would be minor in context of the overall extent of this community on Outer Island.
- **Littoral Disturbance**—The fauna of the littoral community adjacent to the construction site would be disturbed during construction activities, but would recover after completion of the project. The breakwater itself would add structure/habitat for various littoral macroinvertebrates and for fish in the long-term.
- **Endangered Species Impacts**—Alternative 1 would have no impact on populations of state or federal-listed faunal species.

Conclusion—Alternative 1 would have a short-term and long-term, minor, adverse impact on terrestrial faunal components of the clayscape community. This alternative would have a long-term, minor, beneficial impact on the littoral community adjacent to the light station through the addition of underwater structure associated with the breakwater. There would be no impact on state or federal-listed faunal species or on game fish.

Impairment—The limited amount of clayscape community directly impacted by this alternative, the relatively few animal species possibly inhabiting the actual project area, and the fact that no known animal species is dependent upon any unique conditions found within the clayscape community results in a conclusion of no impairment to park fauna from Alternative 1.

5.7.4 Alternative 2 (Revetment—Preferred Alternative)

Analysis—

- **Clayscape Disturbance**—The fill used to treat the bluff slope in this alternative and associated construction activities would destroy habitat for terrestrial fauna existing within the clayscape directly in front of the light station. However, similar habitat and terrestrial faunal communities are found in several locations around Outer Island. The short-term loss/relocation of terrestrial fauna within this portion of the clayscape community would be minor in context of the overall extent of this community on Outer Island.
- **Littoral Disturbance**—Alternative 2 would have somewhat less of an impact on the littoral community since there would be less in-water work needed to build the revetment and the work would be more confined to the shoreline than is the case when constructing breakwaters. There would be short-term construction-related impacts on the littoral zone. However, these impacts would have an overall negligible impact on the littoral community, given less structure placed in the littoral zone.
- **Endangered Species Impacts**—Alternative 2 would have no impact on any populations of state or federal-listed faunal species.

Conclusion—This alternative would have a short-term and long-term, minor, adverse impact on terrestrial fauna in the vicinity of the light station. It would have a negligible impact on the littoral faunal community. There would be no impact on state or federal-listed faunal species or on game fish.

Impairment—The limited amount of clayscape community directly impacted by this alternative, the relatively few animal species possibly inhabiting the actual project area, and the fact that no known animal species is dependent upon any unique conditions found within the clayscape community results in a conclusion of no impairment to park fauna from Alternative 2.

5.7.5 Alternative 3 (Islands)

Analysis—

- **Clayscape Disturbance**—The fill used to treat the bluff slope in this alternative and associated construction activities would destroy habitat for terrestrial fauna existing within the clayscape directly in front of the light station. However, similar habitat and terrestrial faunal communities are found in several locations around Outer Island. The short-term loss/relocation of terrestrial fauna within this portion of the clayscape community would be minor in context of the overall extent of this community on Outer Island.
- **Littoral Disturbance**—Construction of the free-form islands would involve disturbing the littoral community, but this community could be expected to recover post-construction. Introduction of the cobble beach and islands would have short-term, minor, adverse impacts, but would provide increased habitat for the littoral faunal community in the long-term. The addition of cobble beach material and the island structures would add structure/habitat for various littoral macroinvertebrates and for fish.
- **Endangered Species Impacts**—Alternative 3 would have no impact on any populations of state or federal-listed faunal species.

Conclusion—Alternative 3 would have a short-term and long-term, minor, adverse impact on terrestrial fauna in the vicinity of the light station. It would have a short-term minor adverse impact from construction disturbance and a long-term, minor, beneficial impact on the littoral

faunal community adjacent to the light station from increased underwater structure. There would be no impact on state or federal-listed faunal species or on game fish.

Impairment—The limited amount of clayscape community directly impacted by this alternative, the relatively few animal species possibly inhabiting the actual project area, and the fact that no known animal species is dependent upon any unique conditions found within the clayscape community results in a conclusion of no impairment to park fauna from Alternative 3.

5.7.6 Alternative 4 (Submerged Breakwater and Revetment)

Analysis—

- **Clayscape Disturbance**—The fill used to treat the bluff slope in this alternative and associated construction activities would destroy habitat for terrestrial fauna existing within the clayscape directly in front of the light station. However, similar habitat and terrestrial faunal communities are found in several locations around Outer Island. The short-term loss/relocation of terrestrial fauna within this portion of the clayscape community would be minor in context of the overall extent of this community on Outer Island.
- **Littoral Disturbance**—The faunal organisms in the littoral community adjacent to light station waters would be disturbed during construction activities, but would be expected to recover quickly after completion of the project. The addition of the submerged armor stone associated with the breakwater and the face of the revetment would add additional structure/habitat for various littoral macroinvertebrates and for fish, a long-term, minor beneficial impact. There would be minor, short-term loss of habitat and/or relocation for fish species in area in front of the light station, but the habitat would recover following construction.
- **Endangered Species Impacts**—Alternative 4 would have no impact on any populations of state or federal-listed faunal species.

Conclusion—Alternative 4 would have a short-term and long-term, minor, adverse impact on the terrestrial faunal community in the vicinity of the light station. This Alternative would have a short-term, minor, adverse impact, but a long-term, minor beneficial impact on the littoral faunal community adjacent to the light station. There would be no impact on state or federal-listed faunal species or on game fish.

Impairment—The limited amount of clayscape community directly impacted by this alternative, the relatively few animal species possibly inhabiting the actual project area, and the fact that no known animal species is dependent upon any unique conditions found within the clayscape community results in a conclusion of no impairment to park fauna from Alternative 4.

5.8 Impacts on Visitor Use and Experience

5.8.1 Methodology

Impact analysis focused on continued physical access to the light station and to the existing interpretive programs on Outer Island. The experience of being able to personally explore the light station is key to the attractiveness of the site and to its use by the NPS in historic interpretation.

Basis of Analysis—The basis of analysis focused on impacts to short and long-term visitor access and safety at the light stations.

Intensity:

- **Negligible**—Visitor experience and conditions would remain essentially unchanged from the current situation. Any access restriction would not detract from the overall experience of visiting the Outer Island Light Station.
- **Minor**—There would be small, noticeable improvements and/or deterioration in the physical accessibility to Outer Island Light Station and to the availability of interpretive opportunities. Examples of this level of intensity would be small improvements in the tramway stairs or closure of some light station structures other than the lighthouse itself to visitation.
- **Moderate**—There would be noticeable improvement and/or deterioration in interpretive opportunities, exhibits, accessibility, and other visitor amenities. Examples of this level of intensity would be an expansion of the interpretive program to include the interaction of the cultural and natural environments over time, improvements in near-island navigation and boat access, or closure of the lighthouse and other light station structures currently open to visitor exploration.
- **Major**—Interpretive opportunities would be at optimal levels or considerably worse for both indoor and outdoor presentations. Examples of this level of intensity would be a significant increase in interpretive programming on par with that on Raspberry Island or, alternatively, closure of the entire light station complex to visitation.

Duration:

- **Short-Term**—Lasting only during the construction period or no longer than two years.
- **Long-Term**—Essentially a permanent post-construction impact.

5.8.2 No-Action Alternative

Analysis—The No-Action Alternative would allow continuation of current visitor access to the Outer Island Light Station. Current access by private watercraft would continue at least for several years. As the bluff slope continues eroding, visitor access could become problematic in that the tramway stairs could become undermined or otherwise made unsafe because of the erosion. Additionally, the light station structures closest to the bluff top could become structurally unstable and, therefore, unsafe for visitation. Eventually, some of the light station structures might have to be structurally modified, moved, or demolished so as not to create a hazard to authorized or unauthorized visitors. There would be no restriction of Outer Island's hiking trails to visitors with this alternative.

Conclusion—The No-Action Alternative would have short-term, negligible impacts on visitor use and experience. This alternative would have long-term, major, adverse impacts on visitor use and experience.

Impairment—In the long-term, the No-Action Alternative would impair park resources associated with the Outer Island Light Station through making this site, which is important to interpreting the history of the park, unsafe for visitation.

5.8.3 Alternative 1 (Breakwater)

Analysis—Implementation of Alternative 1 would result in construction work in the vicinity of the light station during most of the tourist season over a period of several years. During this time, access to the light station facilities would be maintained by various means of roping off construction areas or otherwise providing safe visitor access to the light station during construction. Visitor access to portions of the light station complex may be restricted during construction periods due to crew members using some light station facilities as temporary housing or for other purposes. Visitor experience would be impacted by the presence of construction equipment and materials as well as by construction noise and dust. There may be a need to place restrictions on watercraft access to the concrete pier in front of the light station during construction. Furthermore, the addition of a breakwater structure would become a new permanent, potential navigation hazard to boaters visiting the island, and currently available dock space would be reduced. There would be no restriction of Outer Island's hiking trails to visitors with this alternative. Frequency of interpretive programs may be impacted during construction, but could be expected to return to pre-construction levels following construction.

Conclusion—Alternative 1 would have short-term, moderate, adverse impacts on visitor access and experience because of construction activities. However, this alternative would have long-term, minor, beneficial impacts for visitors to the park in future years since it would enable interpretation of a unique cultural resource to continue.

Impairment—This alternative directly contributes to fulfilling that part of the park's enabling legislation that charges the NPS with conserving and developing historic resources for inspiration, education, recreational use, and public enjoyment. Therefore, this alternative would not result in impairment.

5.8.4 Alternative 2 (Revetment—Preferred Alternative)

Analysis—Implementation of Alternative 2 would result in construction work in the vicinity of the light station during most of the tourist season over a period of several years. During this time, access to the light station facilities would be maintained by various means of roping off construction areas or otherwise providing safe visitor access to the light station during construction. Visitor access to portions of the light station complex may be restricted during construction periods due to crew members using some light station facilities as temporary housing or for other purposes. Visitor experience would be impacted by the presence of construction equipment and materials as well as by construction noise and dust. There may be a need to place restrictions on watercraft access to the concrete pier in front of the light station during construction. The submerged portion of the revetment should not present any additional navigational hazards east of the concrete pier since this shallow area already contains large boulders and must be avoided by private boaters. Of the action alternatives, Alternative 2 reduces the amount of existing dock space the least. There would be no restriction of Outer Island's hiking trails to visitors with this alternative. Frequency of interpretive programs may be impacted during construction, but could be expected to return to pre-construction levels following construction.

Conclusion—Alternative 2 would have short-term, moderate, adverse impacts on visitor access and experience during construction activities. However, this alternative would have long-term, moderate, beneficial impacts for visitors to the park in future years since it would enable interpretation of a unique cultural resource to continue.

Impairment—This alternative directly contributes to fulfilling that part of the park’s enabling legislation that charges the NPS with conserving and developing historic resources for inspiration, education, recreational use, and public enjoyment. Therefore, this alternative would not result in impairment.

5.8.5 Alternative 3 (Islands)

Analysis—Implementation of Alternative 3 would result in construction work in the vicinity of the light station during most of the tourist season over a period of several years. During this time, access to the light station facilities would be maintained by various means of roping off construction areas or otherwise providing safe visitor access to the light station during construction. Visitor access to portions of the light station complex may be restricted during construction periods due to crew members using some light station facilities as temporary housing or for other purposes. Visitor experience would be impacted by the presence of construction equipment and materials as well as by construction noise and dust. There may be a need to place restrictions on watercraft access to the concrete pier in front of the light station during construction. The free-form islands may present an additional post-construction navigation hazard to boaters attempting to dock near the light station, and the amount of existing dock space would be reduced. There would be no restriction of Outer Island’s hiking trails to visitors with this alternative. Frequency of interpretive programs may be impacted during construction, but could be expected to return to pre-construction levels following construction.

Conclusion—Alternative 3 would have short-term, moderate, adverse impacts on visitor access and experience because of construction activities. However, this alternative would have long-term, minor, beneficial impacts for visitors to the park in future years since it would result in preservation of the unique, historic, cultural resources of the island.

Impairment—This alternative directly contributes to fulfilling that part of the park’s enabling legislation that charges the NPS with conserving and developing historic resources for inspiration, education, recreational use, and public enjoyment. Therefore, this alternative would not result in impairment.

5.8.6 Alternative 4 (Submerged Breakwater with Revetment)

Analysis—Implementation of Alternative 3 would result in construction work in the vicinity of the light station during most of the tourist season over a period of several years. During this time, access to the light station facilities would be maintained by various means of roping off construction areas or otherwise providing safe visitor access to the light station during construction. Visitor access to portions of the light station complex may be restricted during construction periods due to crew members using some light station facilities as temporary housing or for other purposes. Visitor experience would be impacted by the presence of construction equipment and materials as well as by construction noise and dust. There may be a need to place restrictions on watercraft access to the concrete pier in front of the light station during construction, and the amount of available dock space would be permanently reduced. The submerged revetment may present additional navigational hazards. There would be no restriction of Outer Island’s hiking trails to visitors with this alternative. Frequency of interpretive programs may be impacted during construction, but could be expected to return to pre-construction levels following construction.

Conclusion—Alternative 4 would have short-term, moderate, adverse impacts on visitor access and experience because of construction activities. However, this alternative would have long-term, minor, beneficial impacts for visitors to the APIS in future years since it would result in preservation of the unique, historic, cultural resources of the island.

Impairment—This alternative directly contributes to fulfilling that part of the park’s enabling legislation that charges the NPS with conserving and developing historic resources for inspiration, education, recreational use, and public enjoyment. Therefore, this alternative would not result in impairment.

5.9 Impacts on Aesthetics

5.9.1 Methodology

Impact analysis focused on the viewshed from the lake and site integrity of the light station. There would be no change in the aesthetics on the portion of Outer Island outside the immediate vicinity of the light station.

Basis for Analysis—The only basis for analysis is a qualitative interpretation of what each alternative might mean in terms of changes in the viewshed from current conditions. Aesthetics are evaluated primarily from the lakeside view of Outer Island.

Intensity:

- **Negligible**—There would be no change from the existing viewshed conditions surrounding Outer Island noticeable to the occasional repeat visitor although small localized changes associated with on-going geologic and other natural processes would continue.
- **Minor**—Small changes in the viewshed associated with the Outer Island Light Station would be noticeable to the occasional repeat visitor. These changes would be the result of some localized human-associated changes as well as natural processes.
- **Moderate**—Changes to the existing viewshed would be substantial enough that even first-time visitors would note that human-associated activity had recently occurred to change the appearance of the Outer Island Light Station.
- **Major**—Substantial changes to the existing viewshed would occur from human and/or natural disturbances. Changes would be substantial and highly visible such as installation of a large “hard engineered” structure adjacent to the light station or highly visible deterioration of light station structures.

Duration:

- **Short-Term**—Impacts would be primarily associated with construction-related activities.
- **Long-Term**—Impacts would be semi-permanent to permanent changes in the viewshed from the lake or land.

5.9.2 No-Action Alternative

Analysis—The No-Action Alternative would leave the current view of the light station unchanged with future views continuing to depend upon variations in bluff erosion. Should the long-term impact of the No-Action Alternative result in eventual destruction of some (or all) of the light station structures, the aesthetics of the viewshed would be substantially changed. These permanent changes would be considered major and adverse.

Conclusion—The No-Action Alternative would have a negligible, short-term impact, but could have a long-term, major, adverse impact on aesthetics.

Impairment—In the long-term, the No-Action Alternative could impair park aesthetic resources associated with the Outer Island Light Station by allowing the structural deterioration of light station structures, which are an important scenic aspect of the cultural environment that the park is charged to protect through its enabling legislation.

5.9.3 Alternative 1 (Breakwater)

Analysis—Alternative 1 would impact the Outer Island Light Station viewshed from the lake by changing the appearance of the vegetated bluff slope and by construction of the armor stone-covered breakwater structure rising approximately 11 feet above current lake levels and somewhat blocking the view of the shoreline. The view from the land would be temporarily impacted during construction. Although the improvements would change site aesthetics in the short-term and long-term, the toe of the bluff slope tapering into the cobble beach would provide a somewhat natural appearance to the shoreline and minimize aesthetic impacts from the lake. It should be noted that the appearance of the bluff slopes in front of the light station has not been static historically. There is currently more and larger vegetation on the bluff slopes in front of the light station at Outer Island than what appears to be the “historic norm” based on archival photographs.

Conclusion—Alternative 1 would have a short-term and long-term, moderate, adverse impact on the viewshed of the Outer Island Light Station.

Impairment—There would be minor impairment of park aesthetic values with this alternative as a result of the engineering and bioengineering impacts on the lakeside light station viewshed.

5.9.4 Alternative 2 (Revetment—Preferred Alternative)

Analysis—Alternative 2 would alter the view of the Outer Island Light Station from the lake during construction of the regraded slope and revetment. Views from the land over the slope would be similarly affected during construction. The armor stone-covered revetment rising approximately 4 feet above current lake levels would produce a permanent change in appearance to the shoreline at the toe of the slope as seen from the lake. The revetment would be toed into the lake bottom and flanked on either side to make it appear as natural as possible.

Conclusion—Alternative 2 would have a short-term and long-term, minor, adverse impact on the Outer Island Light Station viewshed based on the historic appearance of the light station.

Impairment—There would be minor impairment of park aesthetic values with this alternative as a result of the engineering and bioengineering impacts on the lakeside light station viewshed.

5.9.5 Alternative 3 (Islands)

Analysis—The free-form islands would permanently alter the view of the light station from the lake. However, the partially vegetated islands would somewhat soften the appearance of the stone structures. The islands would taper to lake-level and meet the constructed cobble beach. Views from the land would also be impacted during construction and result in a long-term change following the construction of the islands. Although there would be short-term, adverse

impacts on aesthetics during construction, the islands and cobble beach would be constructed to look as natural as possible in order to minimize any long-term, adverse impacts.

Conclusion—Alternative 3 would have a short-term and long-term, moderate, adverse impact on the historic viewshed of the Outer Island Light Station.

Impairment—There would be minor impairment of park aesthetic values with this alternative as a result of the engineering and bioengineering impacts on the lakeside light station viewshed.

5.9.6 Alternative 4 (Submerged Breakwater with Revetment)

Analysis—Alternative 4 would permanently change the viewshed of the Outer Island Light Station from the lake. The submerged breakwater of armor stone would have a negligible impact on the viewshed providing that the lake does not drop significantly below its already historically low levels. The appearance of the shoreline would also be changed due to the revetment. However, this change would be minimal with the revetment rising only about four feet above the current lake level.

Conclusion—Alternative 4 would generally have a long-term, minor, adverse impact on the viewshed of the Outer Island Light Station from the lake using the historic appearance of the bluff slope and shoreline as a standard.

Impairment—There would be minor impairment of park aesthetic values with this alternative as a result of the engineering and bioengineering impacts on the lakeside light station viewshed.

5.10 Impacts to Cultural Resources

5.10.1 Methodology

Impacts to historic structures were evaluated based upon direct effects of any action on the character-defining features and integrity of the existing light station structures as listed on the National Register of Historic Places (NRHP) or the indirect effects of any action on the cultural landscape encompassing the light station. Direct and indirect impacts of any action on subsurface or underwater archaeological resources were also evaluated.

Basis of Analysis—

- **Historic Structures**—Analysis focused on direct or indirect impacts to NRHP-listed structures associated with the Outer Island Light Station
- **Cultural Landscape**—Analysis was based on impacts to the physical attributes, both natural and built, that contribute to the historical significance of the site as a whole.
- **Archaeological Resources**—Analysis was based on direct and indirect impacts to prehistoric and historic archaeological resources associated with the Outer Island Light Station area.

Intensity:

- **Negligible**—Impacts are barely perceptible and not measurable. For example, normal weathering/deterioration of exterior building finishes, replacement of individual landscape plants, and/or impacts on isolated finds of archaeological resources.

- **Minor**—Any adverse impact that would not affect the character-defining features of the historic light station structures or the overall character of the cultural landscape in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. Beneficial impacts would stabilize and/or continue to preserve the defining features of the NRHP structure(s) and associated landscape elements. Any adverse impact that would result in the loss of individual isolated archaeological artifacts or any beneficial impacts that would enhance preservation of isolated archaeological artifacts.
- **Moderate**—Adverse impacts would alter a character-defining feature(s) of the structure(s) and/or cultural landscape, but would not diminish the integrity of the resources to the extent that National Register status would be jeopardized. Beneficial impacts would stabilize the structure(s) and/or preserve key cultural landscape elements according to the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. An adverse impact that would result in the loss of integrity of an archaeological site composed of multiple components, or any beneficial impact that would either preserve an archaeological site intact or would mitigate impacts by recovery.
- **Major**—Adverse impacts would alter a character-defining feature(s) of the structure or building and/or the cultural landscape to the extent that National Register status would be jeopardized. Beneficial impacts would include complete restoration or stabilization of the structure(s) and/or actions that would preserve, rehabilitate or restore the cultural landscape in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. Adverse impacts resulting in the destruction of an archaeological site having NRHP significance. Preservation and enhancement of an archaeological site having NRHP significance.

Duration:

- **Short-Term**—Impacts would last only during construction or less than two years following construction.
- **Long-Term**—Impacts would be semi-permanent to permanent post-construction changes.

5.10.2 No-Action Alternative

Analysis—

- **Historic Structures**—There would be a negligible, short-term, impact on Outer Island Light Station historic structures with the No-Action Alternative. However, continued long-term erosion of the bluff slope with this alternative could lead to the closure and eventual loss of a significant portion of the historic architectural resources at the Outer Island Light Station—including the lighthouse itself.
- **Cultural Landscape**—As with historic structures, this alternative would have a negligible short-term impact on cultural landscape elements, but with potential significant loss of these cultural landscape elements in the long-term.
- **Archaeological Resources**—This alternative would have a long-term minor adverse impact on subsurface archaeological resources such as the coursed brick remains of an early fog horn house embedded at the edge of the light station bluff.

Conclusion—The No-Action Alternative would have a short-term negligible, but long-term, moderate or, possibly, major, adverse impact on the historic structures on Outer Island. This alternative would have a long-term moderate to major impact on the cultural landscape, and it would have a long-term minor adverse impact on historic archaeological resources.

Impairment—The No-Action Alternative could result in the long-term impairment of park cultural and historic resources associated with the Outer Island Light Station since an important cultural resource that the park is charged with protecting under the enabling legislation would continue to deteriorate and could eventually be destroyed.

5.10.3 Alternative 1 (Breakwater)

Analysis—

- **Historic Structures**—Alternative 1 would not have any short-term impacts on the Outer Island Light Station structures. However, this alternative would have long-term, moderate, beneficial impacts on the preservation of the historic light station structures.
- **Cultural Landscape**—The Outer Island Light Station cultural landscape (primarily encompassing the structures at the top of the bluff slope, but also including the bluff itself) would be changed by Alternative 1 implementation. The general overall impact of this alternative on the light station cultural landscape would be moderately adverse in the long-term.
- **Archaeological Resources**—As with all the action alternatives, Alternative 1 would involve trenching around the periphery of the light station and the possible disturbance of subsurface archaeological resources. There would also be in-water work, which would impact several known submerged historic archaeological resources near the shoreline in front of the light station.

Conclusion—Alternative 1 would have a long-term, moderate, beneficial impact on the historic structures on Outer Island Light Station by providing for long-term soil and foundational stability. This alternative would have a long-term, moderate adverse impact on the cultural landscape of the Outer Island Light Station. Alternative 1 would also have a short-term minor adverse impact on nearshore submerged archaeological resources and, possibly on any, as yet unidentified subsurface archaeological resources.

Impairment—There would be a moderate adverse impact but only minor impairment of the cultural landscape resulting from this alternative since the engineering and bioengineering work in front of the light station would preclude any restoration of the original appearance of the light station.

5.10.4 Alternative 2 (Revetment—Preferred Alternative)

Analysis—

- **Historic Structures**—This alternative would construct a continuous revetment along the base of the bluff slope in front of the Outer Island Light Station and would regrade and revegetate the existing slope. Although this would not have a direct impact on the historic structures on site, there would be indirect, long-term beneficial impacts related to stabilizing the soil and building foundations.
- **Cultural Landscape**—The Outer Island Light Station cultural landscape (primarily encompassing the structures at the top of the bluff slope, but also including the bluff itself) would be changed by Alternative 2 implementation. The general overall impact of this alternative on the light station cultural landscape would be moderately adverse in the long-term.
- **Archaeological Resources**—Alternative 2 would involve trenching around the periphery of the light station and the possible disturbance of subsurface archaeological resources. There

would also be in-water work, which could impact several known submerged historic archaeological resources near the shoreline in front of the light station. However, of the various action alternatives, Alternative 2 would involve the least amount of permanently installed in-water structure.

Conclusion—Alternative 2 would have a long-term, moderate, beneficial impact on the historic structures on Outer Island Light Station by providing for long-term soil and foundational stability. This alternative would have a long-term, moderate, adverse impact on the cultural landscape. Alternative 2 would also have a short-term minor adverse impact on nearshore submerged archaeological resources and, possibly on any, as yet unidentified, subsurface archaeological resources.

Impairment—There would be a moderate adverse impact but only minor impairment of the cultural landscape resulting from this alternative since the engineering and bioengineering work in front of the light station would preclude any restoration of the original appearance of the light station.

5.10.5 Alternative 3 (Islands)

Analysis—

- **Historic Structures**—This alternative would construct several small islands 50-90 feet offshore as well as install a cobble beach at the base of the regraded and revegetated bluff slope in front of the Outer Island Light Station. Although these actions would not have a direct impact on the historic structures on site, there would be indirect, long-term beneficial impacts related to stabilizing the soil and building foundations.
- **Cultural Landscape**—The Outer Island Light Station cultural landscape (primarily encompassing the structures at the top of the bluff slope, but also including the bluff itself) would be changed by Alternative 3 implementation. The general overall impact of this alternative on the light station cultural landscape would be moderately adverse in the long-term.
- **Archaeological Resources**—Alternative 3 would involve trenching around the periphery of the light station and the possible disturbance of subsurface archaeological resources. There would also be in-water work, which could impact several known submerged historic archaeological resources near the shoreline in front of the light station. This alternative probably involved the most extensive in-water work of all the action alternatives.

Conclusion—Alternative 3 would have a long-term, moderate, beneficial impact on the historic structures on Outer Island Light Station by providing for long-term soil and foundational stability. This alternative would have a long-term, moderate, adverse impact on the cultural landscape. Alternative 3 would also have a short-term minor adverse impact on nearshore submerged archaeological resources and, possibly on any, as yet unidentified, subsurface archaeological resources.

Impairment—There would be minor impairment of the cultural landscape resulting from this alternative since the engineering and bioengineering work and island construction in front of the light station would preclude any restoration of the original appearance of the light station as seen from the lake.

5.10.6 Alternative 4 (Submerged Breakwater with Revetment)

Analysis—

- **Historic Structures**—As with the other action alternatives, Alternative 4 would not have a direct impact on the historic structures on site. There would be long-term, indirect beneficial impacts on the historic structures through soil and foundation stabilization.
- **Cultural Landscape**—The Outer Island Light Station cultural landscape (primarily encompassing the structures at the top of the bluff slope, but also including the bluff itself) would be changed by Alternative 4 implementation. The general overall impact of this alternative on the light station cultural landscape would be moderately adverse in the long-term. The submerged breakwater would have a negligible impact on the cultural landscape barring further drops in current low lake levels.
- **Archaeological Resources**—Alternative 4 would involve trenching around the periphery of the light station and the possible disturbance of subsurface archaeological resources. There would also be in-water work, which could impact several known submerged historic archaeological resources near the shoreline in front of the light station.

Conclusion—Alternative 4 would have a long-term, minor, beneficial impact on the historic structures on Outer Island Light Station by providing for long-term soil and foundational stability. This alternative would have a long-term, moderate, adverse impact on the cultural landscape. Alternative 4 would also have a short-term minor adverse impact on nearshore submerged archaeological resources and, possibly on any, as yet unidentified, subsurface archaeological resources.

Impairment—There would be minor impairment of the cultural landscape resulting from this alternative since the bioengineering work and island construction in front of the light station would preclude any restoration of the original appearance of the light station as seen from the lake.

6.0 Unavoidable Adverse Effects

Unavoidable adverse effects from implementing any of the build alternatives on the island would include:

- Destruction of existing vegetation on the bluff slopes.
- Limited temporary degradation of nearshore water quality from sedimentation, bottom disturbance by heavy equipment, and placement of stabilization structures.
- Some level of interference with visitor access to light stations on the island during construction.
- A permanent change from the existing, dynamic clayscape ecosystem in front of the lighthouse to a more uniform and static human-influenced landscape.
- Minor changes in littoral drift dynamics around the island.
- Consumption of energy and resulting emissions associated with construction activities

Assuming that all fill material from mainland sites would come from established quarries and extraction facilities supplying other construction operations in the northern Wisconsin region, the removal of soil and rock natural resources from these sites would not be considered as having an adverse impact on these sites.

The greatest potential unavoidable effect from the No-Action alternative for the island would be the likelihood of significant cultural resource loss.

7.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES INCLUDING ENERGY RESOURCES

Irreversible commitments are those that cannot be reversed, except in the extreme long-term view. Implementation of the Preferred Alternative would irreversibly commit construction materials and fuels needed to complete the erosion control projects. In addition, fossil fuels consumed by construction vehicles and the energy expended to manufacture or extract, process, transport, and place materials and equipment as part of the action alternative would be moderate. All action alternatives at the light station would have negligible impacts on fuel consumption by NPS personnel or by visitors to the light station.

Irretrievable commitments are those that are lost for a period of time, but are not totally irreversible. Changes to the appearance of the light station would be in this category. Irretrievable (generally non-recoverable from the economic perspective) commitments of resources would include the use of rock and other fill materials from mainland sites deposited on and around the islands as part of the build alternatives.

The No-Action Alternative would possibly involve the irreversible and/or irretrievable commitment of minor amounts of resources associated with a continuation of on going stopgap erosion control measures.

The Preferred Alternative (Alternative 2) would involve the irreversible and irretrievable resources such as:

- Loss of the clayscape community directly in front of the light station.
- Loss of fossil fuel resources used by construction equipment.

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